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Report on Techno-Economic Survey of Vidarbha for Agro-Based and Allied Industries

FOR

DEVELOPMENT CORPORATION OF VIDARBHA LTD.,
NAGPUR, MAHARASHTRA

Central Food Technological Research Institute
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P R E A M B L E

At the instance of Development Corporation of Vidarbha Limited, Nagpur vide their letter No.DCVL/Food-Tech/3405, dated 22nd November 1976, a techno-economic survey of Vidarbha Region for establishing food processing industry was undertaken.

The survey report presents districtwise the availability of resources, the present method of post-harvest handling, storage, packaging of raw materials, chemical composition, nutritive values possible toxicological information of various raw materials, available infrastructural facilities and technology. The recommendations have been made for the Development Corporation of Vidarbha Ltd., for taking further necessary steps for the development of the food based industry in this region.

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VIDARBHA AT A GLANCE

Vidarbha Region comprises of eight districts of Maharashtra State viz. Nagpur, Amraoti, Akola, Bhandara, Buldhana, Chandrapur, Yeotmal and Wardha. Its divisional Head Quarters is at Nagpur. It had a total population accounted for 76.12 per cent and the remainder for the urban population. On the State basis, population of Vidarbha was 23.13 per cent. A majority of the population is rural based. The population between age group of 0-14 years accounts for 42.5% of the total population (Table-1). Vidarbha occupies a total area of 97,603 sq.km. which is 31.71 per cent of the total area of Maharashtra State. Though Chandrapur district covers the largest area in Vidarbha (26.27 per cent), it had the lowest density of population (64/sq.km) due to forests. The density of population in the region was highest in Nagpur district

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(196 /sq.km) followed by Bhandara district (172/sq.km) and in the remainder districts it ranged from 102 to 142/ sq.km. The literacy in the region ranged from 26.77 per-cent in Chandrapur district to 45.26 per cent in Nagpur district. Female literacy as compared to males was generally low and was lowest in Chandrapur district (14.54 per cent) and highest in Nagpur district (33.51 per-cent). In other districts the female literacy ranged from 19 to 30 per cent. In regard to male literacy the trend was the same. Chandrapur district can thus be considered to be the most backward district and others in order of literacy are Nagpur, Amraoti, Wardha, Akola, Buldhana, Bhandara and Yeotmal. Number of towns and villages in Vidarbha were 63 and 15,205 respectively. Out of the total number of towns in the region, Nagpur and Amraoti districts accounted for 13 each, followed by Buldhana (9), Yeotmal (8), Chandrapur (7), Wardha (6), Bhandara (5) and Akola (2).

Vidarbha has an extreme climate. The maximum tepera-ture in summer ranges from 41° to 46°C and the minimum in Winter ranges from 11.7° to 18.7°C. The rainfall in a year in the region ranges from 739 mm to 1632 mm (1973). The highest rainfall is in Chandrapur district (1632 mm), followed by Bhandara (1331 mm), Nagpur (1230 mm), Wardha (1173 mm), Yeotmal 1130 mm), Akola (1022 mm), Buldhana (824 mm) and Amraoti (739 mm). The rainy season in the region is from June to September.

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Total number of workers in Vidarbha were 48,97,000 (1971) and they constituted 41.92% of the total population of Vidarbha. The break up of total number of workers showed that 73.5% were agricultural labourers and 26.5% other labourers. Agricultural labourers predominate the region and other category of workers are more in districts which have more towns.

Vidarbha had during the period 1973 to 1975; 1,94,773 educated un-employed persons. Districtwise figures were (i) Nagpur in 1973 (81,350), (ii) Chandrapur in 1974-75 (34,000), (iii) Bhandara in 1973 (27,000), (iv) Akola in 1975(19,000), (v) Amraoti in 1973-74 (15,390), (vi) Wardha in 1974-75(10,784), (vii) Yeotmal in 1972-73(6,300) and Buldhana in 1975 (948).

Vidarbha is virtually the grainary of Maharashtra State because of its rich black and alluvial soil in large parts of the region. The total area sown in the region was 45,64,700 hectares (1972-73), out of 2,10,91,000 hect. in Maharashtra state ie. about 21.4%. The total irrigated area was 3,44,000 hectares ie. about 7.55% of the total cultivable area in the region. The percentage of net area irrigated out of the net area sown districtwise in 1972-73 was 34.4% in Bhandara, 16.6% in Chandrapur, 5.8% in Nagpur, 3.0% in Wardha, 2.6% in Amraoti, 2.6% in Buldhana, 1.9% in Akola and 1.6% in Yeotmal. Vidarbha had thus mainly to depend on monsoon for

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its agriculture to a large extent. Irrigation is carried out from wells, Government canals, tanks and other sources. Efforts are being made to augment these sources through major and minor irrigation projects, etc. Various features of Vidarbha at a glance are given at Table - 2 and their comparison with the State at Table - 3.

TABLE - 1

DISTRICTWISE DISTRIBUTION OF POPULATION ACCORDING TO AGE GROUPS (1971 CENSUS)

Sl. No.	Districts	Age Groups 0-14 yrs.	Age Groups 15 yrs.& above	Total population
1.	Akola	6515	8500	15015
2.	Amraoti	6609	9803	15412
3.	Bhandara	6874	8982	15856
4.	Buldhana	5860	6770	12630
5.	Chandrapur	6829	9572	16401
6.	Nagpur	7982	11445	19427
7.	Wardha	3280	4516	7796
8.	Yeotmal	6210	8027	14237
	Total Vidarbha	49656 (42.5%)	67118 (57.5%)	116774

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TABLE - 3

VIDARBHA & MAHARASHTRA AT A GLANCE

Sl. No.	Item	Unit	Vidarbha	Maharashtra
1.	Location:			
1.1	North latitude	Degree	-	16^{o}-4' to 22^{o}-1'
1.2	East latitude	"	-	72^{o}-6' to 80^{o}-9'
2.	Area & Population:			
2.1	Area	Sq.Km.	97,603	3,07,762
2.2	No.of towns	Nos.	63	289
2.3	No.of villages	Nos.	15,305	38,661
2.4	Rural population	000'	8,889	34,701
2.5	Urban population	000'	4,261	50,412
	Total population	000'	13,150	85,113
2.6	Total Workers:		4,897	18,390
	a) As cultivators & Agri.labours	000'	3,560	11,930
	b) Others	000'	1,174	6,460
2.7	Non-Workers	000'	6,780	32,022
2.8	Literacy percentage:	Percentage		
	a) Male	"	52.55	49.46
	b) Female	"	24.96	26.43
	c) Persons	"	37.21	39.18
2.9	Climate:			
	Rainfall (73)	mms	1135.56	N.A.
3	Temp:			
	a) Maximum	Centigrade	43.42	47.9
	b) Minimum	"	14.35	1.4

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1	2	3	4	5
3.1	Agriculture:			
3.2	Cultivable area	000' Hect.	4,836	21,091
3.3	Area not available for cultivation	"	674	4,296
3.4	Area Sown:			
	a) Net	"	9,245	16,060
	b) Gross	"	16,910	16,980
3.5	Area Irrigated:			
	a) Net	"	339	1,276
	b) Gross	"	344	1,468
3.6	Area under Forest	"	2,713	5,370
3.7	Cropped area under food grains	"	3,506	11,433
3.8	Animal Husbandry (1972):			
	a) Livestock	000'	6,585	26,361
	b) Cattle	"	4,971	14,705
	c) Buffaloes	"	678	3,301
	d) Sheeps	"	145	2,128
	e) Goats	"	1,507	5,911
	f) Poultry	"	2,584	12,217
3.9	Industries:			
	a) Working fact (1973)	Nos.	941	10,663
	b) Average daily employment	"	68,003	10,37,875
4.	Electricity:			
	a) Electric consumed	M.KWH	169623.1	8,812
	b) No.of villages electrified upto 1975	Nos.	6,440	19,515
4.1	Co-operational (1973-74):			
	a) Co-op.Societies	"	10,684	46,764
	b) Working Capital	"	19118.66	2,15,823

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1	2	3	4	5
4.2	Transport & Communication:			
	a) Total Rly.length as on 31.3.72	Kms	1868.74	2,226
	b) Total extra Municipal Rd.length	"	23675.81	1,56,823
	c) No.of Post Offices	Nos.	2,199	9,219
	d) Telegraph Offices	"	210	1,011
4.3	Local Self Govt.(1973-74):			
	a) Village Panchayats	"	6,972	23,329
	b) Municipalities	"	67	227
4.4	Total expenditure during IV Plan:	Lakh Rs.	8,907.67	97,926.00
	Expenditure during V Plan Anticipated expenditure for 1974-75.	"	3,150.8	28,539.00
4.5	Joint stock companies as on 31.3.1974	Nos.	288	8,397
	Banking Offices in the beginning of 31.3.1973.	"	482	3,370
4.6	Employment Exchange:			
	a) Registration	"	99,382	4,21,667
	b) Placement	"	7,244	30,918
	c) Live register at the end of the year.	"	1,98,313	7,07,884

SOURCE:- Socio-economic Review and District Statistical Abstract Government of Maharashtra, Bombay.

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TABLE - 2

VIDARBHA AT A GLANCE

Sl. No.	Item	Unit	Akola	Amra-oti	Buldhana	Bhandara	Chandra-pur	Nagpur	Wardha	Yeotmal
1	2	3	4	5	6	7	8	9	10	11
1.	Location:									
1.1	North Latitude	Degree	19.5° to 21.1°	20°-32' to 21°-46'	19°-51' to 21°-17'	20°-39' to 21°-38'	18°-41' to 20°-50'	20°-35' to 21°-40'	20°-18' to 21°-21'	19°-25' to 20°-40'
1.2	East Latitude	Degree	76.3° to 77.4°	76°-37' to 78°-27'	75°-57' to 76°-49'	79°-37' to 80°-42'	78°-48' to 80°-55'	78°-15' to 75°-40'	78°-4' to 79°-15'	77°-18' to 20°-19'
2.	Area & Population:									
2.1	Area	Sq.km.	10,567	12,210	9,745	9,280	25541.0	9928.0	6,307	[illegible]
2.2	No.of Towns	Nos.	2	13	9	5	7	13	6	8
2.3	No.of Villages	"	1708	1978	1397	1659	3373	1883	1376	1931
2.4	Rural Population	000'	1148	1116	1041	1405	1473	887	589	1230
2.5	Urban Population	"	356	425	222	181	1640	1055	191	194
	Total Population	"	1504	1541	1263	1586	3113	1942	780	1424
2.6	Total Workers:	"	600	593	530	742	665	689	475	603
	a) As Cultivators & Agri.Labours	"	490	466	452	524	539	345	233	511
	b) Others	"	110	127	78	219	132	344	72	92
2.7	Non-Workers	"	901	948	733	843	976	1253	305	821

1	2	3	4	5	6	7	8	9	10	11
.8	a) Male Literacy	Per cent	51.84	52.28	51.3	50.1	38.63	56.09	52.55	42.87
	b) Female "	"	26.48	31.69	22.7	20.59	14.54	33.5	30.29	19.83
	c) Person "	"	39.55	42.36	37.3	35.40	26.77	45.25	41.71	31.60
.9	Climate:									
	Rain fall (73) .	mm.	1022.4	739.0	824.4	1331.8	1632.1	1270.5	1130.5	-
3.	Temp:									
	a) Maximum	$0^{o}C$	43.2	41.4	37.8	44.2	45.5	44.9	46.2	44.2
	b) Minimum	$0^{o}C$	14.1	13.8	-	13.2	13.6	18.7	15.2	11.7
.1	Agriculture:									
.2	Cultivable area	000'Hect.	859	759	-	452	806	609	469	932
.3	Area not available for cultivation	"	120	51	49	96	152	79	44	
.4	Area sown:									
	a) Net	"	799	700	18	387	667	5431	429	819
	b) Gross	"	8150	710	23	481	710	5567	438	831
.5	Area Irrigated:									
	a) Net	"	15	21	-	134	110	32	13	14
	b) Gross	"	17	23	-	134	111	32	13	14
.6	Area under Forest	"	76	337	118	249	1454	185	37	257
.7	Cropped area under Food grain	"	416	304	726	444	578	401	230	407
.8	Animal Husbandry (72):									
	a) Livestock	000'	844	780	781	139	1541	871	540	1089
	b) Cattles	"	543	508	487	647	1079	603	374	730

1	2	3	4	5	6	7	8	9	10	11
	c) Buffaloes	000'	90	73	71	109	135	60	45	95
	d) Goats	"	190	166	185	179	264	174	106	243
	e) Sheeps	"	8	20	29	2	49	22	9	6
	f) Poultry	"	175	185	120	500	830	237	124	413
3.9	Industries:									
	a) Working Factories (1973)	Nos.	100	94	44	182	48	348	51	74
	b) Average daily employment	"	7531	5398	3243	4859	6007	28477	6812	5176
4.	Electricity(Consumed 1973-74)	M.KWH	51	781	35	166,688	1675	320	43.07	30.03
	No.of Villages electrified (upto 75)	Nos.	719	1059	624	729	530	1085	689	100
4.1	Co-operation(1973-74):									
	a) Co-op.Societies	"	1387	1362	111	1228	1682	2037	857	1220
	b) Working Capital	Lakh Rs.	2401	3366	1181	1508.66	15,50	3981	1842	3289
4.2	Transport & Communication:									
	a) Total Rly.length as on 31372	Kms.	354	194.47	82	253	996	463.16	144	82.11
	b) Post Offices(72-73)	Nos.	332	327	304	231	275	284	157	289
	c) Municipal Rd. length	Kms.	2874	3365.47	3028	2854	2825	2525.4	2330	3874
	d) Telegraph Offices	Nos.	25	45	20	19	27	45	12	17

1	2	3	4	5	6	7	8	9	10	11
4.3	Local Self Govt.(73-74):	Nos.								
	a) Village Panchayat	Nos.	945	759	773	1000	1226	678	472	1119
	b) Municipalities	"	9	13	9	5	5	12	6	8
4.4	Total expenditure during IV Plan.	Lakh Rs.	1179.35	1357	918.74	1080	949.53	1281.30	601.81	1539.94
	Expenditure during V Plan anticipated expenditure for 74-75	"	412.50	314	261.57	659	425.77	505.57	212.07	330.94
4.5	Joint Stock Companies (31.3.74)	Nos.	34	44	7	19	4	158	15	7
	Banking Offices (31.3.73)	"	59	63	65	47	50	111	34	53
4.6	Employment Exchange:									
	a) Registration	"	9214	7514	5792	10564	20234	36529	5477	4[illegible]
	b) Placement	"	731	522	432	501	2115	2017	566	385
	c) Live registered at the end of the year	"	19328	15390	948	27416	36711	81351	10784	6385

SOURCE:- Socio-Economic Review and District Statistical Abstract, Govt.of Maharashtra, Bombay.

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CHAPTER - I

IMPORTANCE OF THE PROPOSED INDUSTRY

1.1 Vidarbha is mainly a rural based agricultural region and its economy largely depends on its agricultural produce. The food processing industry is of vital importance as it constitutes to be an essential adjunct for preservation, conservation and transport of the perishable food commodities grown in the region. The post-harvest technology of the food commodities needs urgent attention as losses to the extent of about 10-15% have been reported during various stages of their handling and transport. The methods followed at present are mostly traditional and often utilisation of valuable by-products is over-looked. The Agro-based food processing industry also lends scope for industrialisation of the region and for offering remunerative

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returns to the growers. The overall economy of the region is very closely linked with the rapid development of the food processing industry on modern scientific lines and a growing awareness in this regard has been well established in all quarters. The children and expectant mothers constitute the vulnerable section of the population. Children alone account for over 42 % of the population between age group of 0-14 years in the region. Adequate provisions have been made in the budget to meet the requirements of the school children feeding programme and for tribal welfare. There is a need for introducing a standard, nutritionally rich and hygienically prepared low cost products like energy food, MPF, at district level in the region.

1.2 Existing Status:

The food processing industry in Vidarbha at present comprises of mainly rico mills, dal mills and oil mills. Besides these, there are bakeries, soda water factories, flour mills (Chakki), Poha units, three Cold Storages, five Fruit & Vegetable Preservation Units (Licenced under the F.P.O.1955), etc. There is also One of the largest fruit and vegetable canneries owned now by M.A.I.D.C., Bombay, and a Soya-milk making unit. Recent additions are six solvent extraction plants, 2 mechanised wheat

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flour mills, a mechanised biscuit and bread making plant, 2 ice-cream plants, a unit for making starch from maize, a hydrogenation plant, 2 sugar mills and a few Khandsari (Sugar) units, etc. District-wise break up of registered Food Processing Industry in the region for 1972 is given at the (1.1 & 1.2).

1.3 Rice Milling:

Rice Milling Industry is the largest food processing industry in the region and is mainly confined to two districts viz. Bhandara and Chandrapur, which constitute the rice bowl of the region. There are about 860 rice mills in the region, out of which about 500 are in Chandrapur district, 350 in Bhandara district and 10 in Nagpur district. In 1973, units registered under the Factories Act were 70 in the region. A majority of them is of huller type with a capacity of milling ½ to 1 tonne of paddy per hour. Organised rice mills in the region are of two types namely (i) Sheller-cum-cone polisher and (ii) Sheller-cum-huller. The exact number of each type is not known, though it is essential for modernisation of rice mills. It is however reported that there are 93 to 97 rice mills in Chandrapur district which use shellers for milling paddy. In Bhandara district large quantity of rice is milled at Gondia, Lakhni and Tumsar. In Chandrapur district the main centres are (i) Mul(3),

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(ii) Bindewahi(4), (iii) Kalodhi(Balapur)(4), (iv) Nagbhir (4), (v) Brahmapuri(3), (vi) Wadsa(4), (vii) Armori(3),etc. In Bhandara district, it is said, that the huller type of mills are so scattered that there is a rice mill at a distance of every ten miles.

Data regarding production in terms of value, investment for land and building, machinery and number of workers pertaining to 184 registered rice mills with Joint Director of Industries are listed in Table 1-3 and 1-3-A. Rice milling industry in Bhandara district is spread over its three Tahsils and its break up (i) Gondia(82), (ii) Bhandara(44), and (iii) Sakoli(18). Its tahsil-wise break up in Chandrapur district is as follows: (i) Chandrapur(11), (ii) Gadchiroli(10), Warora(4), (iv) Brahmapuri(2), and (v) Rajura(2). In Nagpur district, it is Ramtek(7) and two each in Nagpur and Umred tahsils. The capital investment of these mills in Bhandara district amounted to Rs. 71,81,384/- (a) Land & Building Rs.32,86,590 and (b) Plant & Machinery Rs.38,94,794. In Chandrapur district it amounted to (a) land and building Rs.8,12,400 (b) plant and machinery Rs.4,29,925 totalling to Rs.12,91,200 and in Nagpur district it was (a) land and building Rs.2,86,800 (b) plant and machinery Rs.2,88,300 totalling to Rs.5,75,100. Out of a total production of rice in terms of value of Rs.1,68,91,150 for these units, the tally was

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(i) for Bhandara district Rs.1,54,28,330 (ii) Chandrapur district Rs.12,91,200 and (iii) Nagpur district Rs.1,71,630.

The workers employed in these units were (1) Bhandara district 763, (2) Chandrapur district 183 and (3) Nagpur district 53, totalling 999. From all the considerations as given above Bhandra dist. of the main hub of the rice milling industry followed by Chandrapur district in the region.

One quintal of paddy on milling in a disc type sheller-cum-cone polisher yields about 67 to 68 per cent raw rice and in the old huller type mills, the yields are 64 to 65 per cent. The Engelberg type mills give an yield of about 69 per cent. The bran and the husk obtained as by-product from the traditional rice mills cannot be economically utilised as they are obtained in a mixture. It is estimated that about 24,800 M.T. of rice bran (1973-74) are available. In Bhandara district as no other fodder is available in adequate quantities, rice bran is mainly used as cattle feed. Rice bran is sold at Rs.80 to 90 per quintal for feed purposes. Quantity of husk (including bhusk) is estimated to be 1,60,992 M.T. (1973-74); and the same is used mainly as fuel and for manure. At present there is only one solvent extraction plant in operation at Karaha near Bhandara with a capacity of 50 tonnes/day. This unit was set up in the year 1971 in

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co-operative sector and depended for supply of bran in 26 co-operative rice mills in the district. Since adequate quantities of rice bran was not available from these sources, they are procuring the same from Raipur, Balaghat in Madhya Pradesh and other sources, besides using oil seed cakes, sal seed, babul seed, etc. Other five solvent extraction plants are situated in oil seed producing districts namely - Wardha(2), Akola(1), Buldhana(1) and Yeotmal(1). From the review of rice milling industry in Vidarbha, problems faced by the industry are listed in summary form as follows:

(1) Production of paddy is not sufficient to feed 860 rice mills, (2) the present capacity is in excess to the tune of 40% on single shift basis, (3) There is a scarcity of funds for stocking paddy and essential repairs, (4) Unheathy competition, results in the reduction of milling rates and profits, (5) Under the Rice Milling Regulation Act (1958) establishment of new rice mills is prohibited. Priority is however, given to co-operatives for setting up rice mills and 35 co-operative rice mills have been planned for Bhandara district by Maharashtra State Industries Commission, (6) Utilisation of by-products like husk, rice bran and broken rice needs attention. For this purpose ten rice mills should forge a link, and trade association should

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play their role for the state, and (7) 4 to 1 tonne capacity units should all be brought under co-operative sector and small huller plants being wasteful and uneconomic should be progressively eliminated.

Poha Units:

The coarse varieties of rice are used for the manufacture of Poha. There were 58 Poha units in Vidarbha in 1972 and only 29 are registered with the Joint Director of Industries. In Bhandara district alone there were 43 Poha units of which 23 were old ones and 20 were new. They are located at Gondia, Tumsar and Lakhani in Bhandara district. Out of the remainder poha units, Chandrapur district accounted for 10, Nagpur and Akola districts 2 each and Amraoti district 1. The centre of Poha production in Chandrapur district is around Armori, in Nagpur district at Nagpur and in Akola district at Akola. The yield of poha is about 55%. The total production of poha in terms of value in the year 1972 was Rs.20,90,600 and the investment in equipment and machinery was Rs.6,97,500. Out of 29 registered units, the maximum and minimum capital investment was Rs.35,000 and Rs.7,000 and the value of poha produced was Rs.2,48,000 and Rs.7,000 respectively. Amongst these 29 units, 9 units produced poha worth more than 1 lakh rupees per annum, 14 units produced poha between Rs.50,000 to 1 lakh and

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6 units produced less than Rs.50,000. The districtwise distribution of poha units on their production value is given in Table - 1-4.

Table - 1-4

Districtwise distribution of Poha Units on Production Value

Annual production in value (1972).	Bhandara	Chandrapur	Nagpur	Amraoti	Akola	Total
1. Rs.more 1 lakh	3	5	1	-	-	9
2. Rs.50,000 to 1 lakh	6	4	1	1	2	14
3. Rs.50,000	5	1	-	-	-	6
Total	14	10	2	1	2	29

1.4 Dal Milling:

Dal milling industry is the second largest food processing industry of the region, and there were 46 registered dal mills in 1972. 8 of these units also do flour milling along with dal milling. The main pulses used for milling is tur, bengalgram, greengram and blackgram is also milled to some extent. Out of these 46 mills, more than half the units are located at Nagpur(16) and Akola(9) districts and distribution of the remaining mills district-wise is - Buldhana(5), Amraoti and Yeotmal(4) each, Wardha(3) and

Districtwise data regarding number of dal mills, capital investment, production in terms of value, investment in plant and machinery as well as the number of workers, etc are given at Table - 1-3. In Nagpur district all the dal mills(16) are located in Nagpur tahsil only and in Akola district(9) there are 5 units at Akola and the remaining at Akot(3) and Washim (1). Its tahsilwise distribution in other district is, Yeotmal district; Khamgaon(4) and Malkapur(1), Buldhana district; Yeotmal(4), Amraoti(2) and Achalpur(2), Amraoti district; Wardha(2) and Arvi(1), Wardha district: Gondia(2), Chandara district: Chandrapur(1) and Warora(1).

The capital investment of Dal mills in Vidarbha amounted to (1) Land and building Rs.68,42,200 (2) Plant and machinery Rs.10,77,000 totalling to Rs.79,19,200. In Nagpur district it was (a) Land & Building Rs.58,36,500 (b) Plant & Machinery Rs.4,69,000 totalling to Rs.63,05,500 and in Akola district it was (a) Land & Building Rs.3,68,700 (b) Plant & Machinery Rs.2,61,500 totalling to Rs.6,30,200.

Total production of dal in Vidarbha in terms of value was Rs.3,04,24,100 in 1972. Nagpur district was the highest in production in terms of value (Rs.1,73,40,550) followed by Akola (Rs.1,38,06,700). In other districts

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it was (i) Yeotmal Rs.97,30,000 (ii) Buldhana Rs.34,56,000 (iii) Amraoti Rs.33,17,150 (iv) Wardha Rs.5,38,300 (v) Bhandara Rs.1,91,500 and (vi) Chandrapur Rs.52,000.

Most of the dal mills work for eight months in a year (January to June and September to December) except for the four months of rainy season. The workers employed in this industry districtwise are, Nagpur district(173), Akola district(99), Wardha(98), Yeotmal (74), Amraoti(70), Bhandara(10) and Chandrapur(6) totalling to 578. A unit located at Yeotmal had the highest annual turnover on value basis of Rs.50.0 lakhs. There were 36 units in Vidarbha whose annual production value was more than Rs.one lakh, and 10 units with less than one lakh production.

The yield of tur dal obtained is about 70 per cent. The other product of milling tur is chuni(28%) which includes 10% bits, powder and 18% husk. The remaining 2% is extraneous matter. When the price of tur dal is Rs.360/quintal, the chuni fetches Rs.110/quintal and the broken dal Rs.200/quintal. Chuni at present is used as a Cattle feed.

Though the production of Tur and green gram is highest in Yeotmal district, there are only four registered dal mills at Yeotmal and Nagpur has the highest

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number of dal mills(16). The case is the case with Amraoti and Wardha districts. It will be beneficial to correct this imbalance by creating additional capacity in tur dal growing districts like Yeotmal, Amraoti, Wardha and Buldhana districts and also by modernising the existing dal mills for increasing yields. Since great emphasis is at present being laid on increasing production of pulses as a national policy, setting up of modern dal mills in these districts, on a co-operative basis, will be justified. It will be necessary to provide adequate financial assistance for this purpose.

1.5 Oil Milling:

Oil milling industry is one of the oldest industry in the region and there were 104 oil mills in 1972. Nearly 2/3 of these oil mills are located in Wardha(39) and Amraoti(32) districts and the remaining are in Chandrapur (16), Nagpur(10), Buldhana(4), Bhandara(4) and one each in Akola and Yeotmal districts. Groundnut and Linseed oils are largely used by the population. A survey regarding the working of sick oil mills in the co-operative sector has been carried out separately by the Development Corporation of Vidharbha Ltd., and the remedial measures have been suggested for their improvement.

Mahua seeds are one of the valuable forest products but are not being commercially utilised at present for

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extraction of oil. The oil content in the seeds is 51%. The oil is used mainly for non-edible purposes in the manufacture of soap, hair oils, etc. In a survey carried out by S.I.E.T., Hyderabad (1973) it is reported that 12,900 tonnes of Mahua seeds are collected from the forest areas in central Vidarbha. Enquiries made at Chandrapur revealed that 8,400 tonnes of Mahua flowers are produced in the forest areas in the district however, no estimate about the seeds could be had. Mahua Kernel constitutes 70% of the seed. Yield of oil by crushing in a Ghani is 20 to 30% and in an expeller it is 34 to 37%. The oil cake can be used in fields where sugar cane is grown, though it may be used in admixture with other cakes as a manure. Higher yields of oil can be obtained by solvent extraction. To utilise this valuable forest produce, existing oil mills in Chandrapur district can take up its crushing beneficially. In Yeotmal district, however, due to paucity of oil mills, one oil mill can be set up at Pusad or Pandharkawda for this purpose.

The commercial oil cake is sold mainly as a cattle feed. It is also utilised by the solvent extraction plants to recover oil from the cake. Oil cakes are also used for manuring purposes. Though edible grade oil cakes can be used for the manufacture of protein foods, no attempt in this direction has so far been made in this

region despite its potential for the same. There are two hydrogenation plants (Vanaspati) one each at Nagpur and Akola. Based on Soyabean, no plant at Nagpur is manufacturing soya-milk and another protein foods at Wardha. A few units for the manufacture of Soya flour and Soya products were started at Nagpur but have since been closed down.

Solvent Extraction Plants:

There are seven solvent extraction plants in the region. Their locations and capacity/per day are as follows:

Location	No. of plant	Capacity tonnes/day
Wardha	3	2 x 50 1 x 75
Akola	1	1 x 50
Khangaon	1	1 x 100
Bhandara	1	1 x 50
Yeotmal	1	Not known.

It is estimated that the capital investment of five units is Rs.2.25 crores. The commodities handled by these units generally are oil seed cakes like groundnut, cotton seed, salflower, soyabean and rice bran. Other commodities handled for extraction include neem seed, babul seed, mango stones, rape seed, sal seed, mahua seeds, etc. Khangaon unit has made a pioneering effort in collection

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f mango stones by offering suitable incentives and through publicity from sources scattered all over the region as well as from outside. Mango kernels (dried) yield a butter like fat (M.P.37°C) which has a good export market. It replaces Cocoa-butter used in the manufacture of confectionary and chocolates. The fat content of the mango kernel varies from 7 to 13% depending on the variety of mangoes. The fat content in Alphanso mangoes is the highest (12 to 13%) and in Totapuri mangoes the lowest (7 to 8%). In common varieties it is on average about 10%. In 1976-77, 310 tonnes of mango fat packed in drums were exported. Collection of properly dired mango stones (below 10% moisture content) to avoid development of more than 3 to 4% F.F.A. is however still a difficulty. Oils extracted (FFA 1 to 3%) from oil seed cakes are mostly sold to oil refineries and deoiled cakes are exported to Japan and European countries. The commodities used for solvent extraction are procured from Madras, Gujarat, Madhya-Pradesh, etc. to utilise the installed capacity of the plants. Hexane (food grade) is used as the solvent and its losses are 4 to 5 liters per tonne. Some of the problems faced by this industry are summerised as follows:

(i) Safflower cake is brought from Marathwada. By the time the cake arrives and stored at the plant premises,

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it burns by itself in a fortnight. In extreme cases it gets charred. The cake on removal of oil, however, does not burn. Opposite is the case with neem seed cake. Though rice bran also burns, it is not as fast as safflower cake. In the case of safflower cake the oil content gets reduced from 8 to 4%, when it is smoking. The colour of the extracted oil becomes red and on further storage it turns black. Dehusking of safflower is also difficult. (ii) African countries are using cardboard cartons for packing of 20 to 25 kgs. mango fat filled in Polythene bags. To reduce the cost of packaging, such a package should be developed for export purposes. (iii) An instrument for detection of solvent leaks from the plant should be made available. (iv) Bleaching of sal fat and removal of tannins from the deoiled cake for use in feed purposes. (v) Removal of waxes from sunflower oil without winterisation and (vi) Non-availability of good quality raw materials for extraction.

Other food processing industries in the region include Bakery & Confectionaries(60), Fruit & Vegetable Processing Units licenced under FPO 1955, including aerated water units (74), Cold Storages(2), Ice factories(11), Ice Candy(7), Ice-cream(2), Spices(4), Starch from Maize and tamarind seed one each, Sugar factories(2), Khandsari(2) and Desiccated coconut units(4).

Total investment and production of food processing industries in Vidarbha (1972) are listed in Table 1-5.

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TABLE - 1-1

DISTRICTWISE BREAK UP OF DIFFERENT FOOD PROCESSING INDUSTRIES IN VIDARBHA
(1972)

Sl. No.		Akola	Amra-oti	Bhan-dara	Buld-hana	Chand-rapur	Nagpur	Yeo-tmal	Wardha	Total in Vidarbha
1	2	3	4	5	6	7	8	9	10	11
1.	Fruit & Vegetable*	-	5	-	1	-	12	-	-	18
2.	Rice Mill	-	-	144	-	29	11	-	-	184
3.	Poha Mill	2	1	14	-	10	2	-	-	29
4.	Dal Mill	6	4	2	5	2	12	4	3	38
5.	Dal & Flour Mill	3	1	-	-	-	4	-	-	8
6.	Solvent +	1	-	1	1	-	-	1	2	6
7.	Bakery and Confectionary	4	2	16	9	5	18	3	3	60
8.	Soda Water	3	6	17	-	3	14	9	4	56
9.	Beverages	-	-	-	-	-	1	-	-	1
10.	Ice Factory	1	2	2	2	2	1	1	-	11
11.	Ice Candy	1	-	1	3	1	-	1	-	7
12.	Cold Storage	-	-	-	-	-	1	1	-	2
13.	Ice Cream	-	-	-	-	-	2	-	-	2

1	2	3	4	5	6	7	8	9	10	11
14.	Starch	-	-	-	-	1	-	-	-	1
15.	Khandsari +	-	-	1	-	-	-	-	-	1
16.	Flour Mill	-	-	1	-	1	1	-	-	3
17.	Miscellaneous	-	-	-	-	-	4(Dessi-cated coconut)	-	1(Protein Food)	
18.	Spices	2	-	-	-	-	-	-	2	4

SOURCE - Joint Director of Industries, Industries Office, Government of Maharashtra, Nagpur.

* - Made upto date from FPO list

\+ - Recent addition.

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TABLE - 1-2

TALUKWISE DISTRIBUTION OF FOOD PROCESSING INDUSTRIES IN VIDARBHA (1972)

District & Taluk	Rice Mill	Dal & Flour Mill	Flour Mill	Poha	Solvant extraction	Fruit & Vegtable	Spices	Cold storage	Ice Fy.	Ice Candy	Bakery & Confectionary	Soda water	Khandsari	Starch
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Akola:														
Akola	-	2+3	-	2	1	-	-	-	1	1	4	2	-	-
Akot	-	3	-	-	-	-	2	-	-	-	-	1	-	--
Murtizapur	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mangrulpir	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Washim	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Balapur	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dist.Total	Nil	6+3	Nil	2	1	Nil	2	Nil	1	1	4	3	Nil	Nil
Amraoti:														
Amraoti	-	2+1	-	1	-	5	-	-	1	-	-	4	-	-
Achalpur	-	2	-	-	-	-	-	-	1	-	1	-	-	-
Morshi	-	-	-	-	-	--	-	-	-	-	-	-	-	-
Chandur	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Daryapur	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Melghat	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dist.Total	Nil	4+1	Nil	1	Nil	5	Nil	Nil	2	Nil	2	6	Nil	Ni

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1
Buldhana:															
Buldhana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Chikhli	-	-	-	-	-	-	-	-	-	2	1	-	-	-	
Mehekar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Khamgaon	-	4	-	-	1	1	-	-	-	1	3	-	-	-	
Malkapur	-	1	-	-	-	-	-	-	2	-	3	-	-	-	
Jalgaon	-	-	-	-	-	-	-	-	-	-	2	-	-	-	
Dist.Total	Nil	5	Nil	Nil	1	1	Nil	Nil	2	3	9	Nil	Nil	Nil	N
Bhandara:															
Bhandara	44	-	-	6	1	-	-	-	-	1	4	10	-	-	
Gondia	32	2	1	8	-	-	-	-	2	-	10	7	-	-	
Sakoli	18	-	-	-	-	-	-	-	-	-	2	-	1	-	
Dist.Total	114	2	1	14	1	Nil	Nil	Nil	2	1	16	17	1	Nil	N

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Ice Cre
Chandrapur:															
Chandrapur	11	1	1	-	-	-	-	-	1	-	5	-	-	-	-
Warora	4	1	-	-	-	-	-	-	-	-	-	1	-	-	-
Brahmapuri	2	-	-	2	-	-	-	-	-	1	-	1	-	-	-
Gadchiroli	10	-	-	8	-	-	-	-	1	-	-	1	-	-	-
Sironcha	-	--	-	-	-	-	-	-	-	-	-	-	-	-	-
Rajura	2	-	-	-	-	-	--	-	-	-	-	-	-	-	-
Dist.Total	29	2	1	10	Nil	Nil	Nil	Nil	2	1	5	3	Nil	Nil	Nil
Nagpur:															
Nagpur	2	12+4	1	2	-	11	1	1	1	-	18	13	-	-	2
Umrer	2	-	-	-	-	1	-	-	-	-	-	1	-	-	-
Kalol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saoner	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ramtek	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dist.Total	11	16	1	2	Nil	12	1	1	1	Nil	18	14	Nil	Nil	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Wardha:															
Wardha	-	2	-	-	2	-	2	-	-	1	3	2	-	-	-
Arvi	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-
Hingonghat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dist.Total	Nil	3	Nil	Nil	2	Nil	2	Nil	Nil	1	3	4	Nil	Nil	Nil
Yeotmal:															
Yeotmal	-	4	-	-	1	-	-	1	1	-	3	8	-	-	-
Kelopur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pusod	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
Darwha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dist.Total	Nil	4	Nil	Nil	1	Nil	Nil	1	1	1	3	9	Nil	Nil	Nil

SOURCE: Joint Director
Industries Office
Govt.of Maharashtra
N A G P U R.

TABLE - 1-3

(Value - '000 Rs.) INVESTMENT AND PRODUCTION OF FOOD PROCESSING INDUSTRIES IN VIDARBHA (1972)

District		Akola			Amraoti			Bhandara			Buldhana	
		Investment LB & PM	Total Investment	Production	Investment LB & PM	Total Investment	Production	Investment LB & PM	Total Investment	Production	Investment LB & PM	Total investment
1		2	3	4	5	6	7	8	9	10	11	12
Fruit & Veg.	LB	-	-	-	70	84	80	-	-	-	-	3.6
	PM	-	-		14			-	-	-	-	
Rice	LB	-	-	-	-	-	-	3286.6	7181.4	15428.3	-	-
	PM	-			-			3894.8			-	
Poha	LB	28	100	136	50	62	90	97.4	206	901.3	-	-
	PM	72			12			108.6			-	
Dal	LB	260.7	373.2	10279	107.5	189.5	3317.15	35.0	70	191.5	-	1373.0
	PM	112.5			82.0			35.0			-	
Dal & Flour	LB	149	257.0	3527.7	-	-	-	-	-	-	-	-
	PM	108			-			-			-	
Solvant Ext. Unit.	LB	2500.00	5000.0	5000.0	-	-	-	2500.0	2860.0	-	-	3800.0
	PM	2500.00			-			360.0			-	
Bakery & Conf.	LB	21.5	31.45	65.0	3.0	3.35	3.0	52.2	95.8	625.4	-	67.5
	PM	9.95			0.35			43.6			-	
Soda Water	LB	28.0	133.0	1124.0	87.75	136.8	149.0	42.7	127.5	88.8	-	-
	PM	105.0			49.0			84.7			-	

1		2	3	4	5	6	7	8	9	10	11	12	13
Ice Factory	LB	50.0	147.5	49.5	39.6	206.2	70.37	22.5	86.5	26.0	-	39.0	45.
	PM	97.5			166.7			64.0			-		
Ice Candy	LB	-	3.6	3.0	-	-	-	-	10.0	6.0	-	38.8	39.
	PM	-			-			-			-		
Cold Storage	LB	-	-	-	-	-	-	-	-	-	-	-	-
	PM	-			-			-			-		
Ice Cream	LB	-	-	-	-	-	-	-	-	-	-	-	-
	PM	-			-			-			-		
Khandsari	LB	-	-	-	-	-	-	7.0	25.0	N.A.	-	-	
	PM	-			-			18.0			-		
Flour Mill	LB	-	-	-	90.0	120.0	206.18	17.0	23.3	5.3	-	-	-
	PM	-			30.0			6.5			-		
Spices	LB	25.0	40.0	12.0	-	-	-	-	-	-	-	-	-
	PM	15.0			-			-			-		

LB - Land & Building

PM - Plant & Machinery

		Chandrapur			Nagpur			Wardha			Yeotmal	
		Investment LB & PM	Total Investment	Production	Investment LB & PM	Total Investment	Production	Investment LB & PM	Total Investment	Production	Investment LB & PM	Total Investment
		14	15	16	17	18	19	20	21	22	23	24
Fruit & Veg.	LB	-	-	-	1550.0	2830.0	6500.0	-	-	-	-	-
	PM	-			1280.0			-			-	
Rice	LB	812.4	1242.3	1291.2	236.8	575.1	171.6	-	-	-	-	-
	PM	429.9			288.3			-			-	
Poha	LB	152.0	259.5	937.3	60.0	70.0	160.0	-	-	-	-	-
	PM	107.5			10.0			-			-	
Dal	LB	13.0	22.5	52.0	5393.5	5705.5	10172.85	90.0	185.0	538.3	392.0	517.0
	PM	9.5			312.0			95.0			125.0	
Dal & Flour	LB	-	-	-	443.0	6000.0	7167.7	-	-	-	-	-
	PM	-			157.0			-			-	
*Solvant Ext.	LB	-	-	-	-	-	-	391.0	1091.0	5240.9	N.A.	N.A.
	PM	-			-			700.0				
Bakery & Conf	LB	23.0	39.5	143.0	24.0	232.54	2209.0	17.0	53.0	322.6	9.5	16.4
	PM	16.5			208.54			36.0			6.9	
Soda Water	LB	30.5	70.8	53.8	406.0	1409.0	633.0	-	70.7	25.4	149.5	264.5
	PM	40.3			603.0			-			115.0	
Ice Factory	LB	900.0	305.0	57.0	25.0	65.0	25.0	-	-	-	7.0	12.0
	PM	215.0			40.0			-			5.0	
Ice Candy	LB	18.0	36.0	20.0	-	-	-	-	-	-	-	16.0
	PM	18.0			-			-			-	

		14	15	16	17	18	19	20	21	22	23	24	25
Cold Storage	LB	-	-	-	466.67	604.67	18251 Qt	-	-	-	47.0	150.0	100.
	PM	-			138.0			-			103.0		
Ice Cream	LB	-	-	-	60.0	295.0	300.0	-	-	-	-	-	-
	PM	-			235.0			-			-		
Flour Mill	LB	22.0	42.2	400.0	400.0	730.0	8400.0	-	-	-	-	-	-
	PM	-			330.0			-			-		
Spice	LB	-	-	-	On-lease	6.0	6.0	7.5	82.5	12.5	-	-	-
	PM	-			-			75.0			-		
Misc.(Copra Unit Protein Food)	LB	-	-	-	15.44	94.24	1840.75	(Protein - Fd.)	5.0	24.0	-	-	-
	PM	-	-		78.8						-		

* Figures of Four Units are compiled.

TABLE - 1-3A

NO.OF FACTORIES & WORKERS IN FOOD PROCESSING INDUSTRIES IN 8 DISTRICTS OF VIDARBHA (1972)

	No.of Fy.	No.of Workers								
		Akola	Amr-aoti	Bhan-dara	Buld-hana	Chandr-apur	Nagpur	Wardha	Yeot-mal	Vida-rbha
Fruit & Vegetable	18	-	35	-	7	-	N.A.	-	-	42
Rice	184	-	-	763	-	183	53	-	-	999
Poha	29	-	6	77	-	82	14	-	-	179
Dal)	38) 46	99	70	10	48	6	173	98	74	578
Dal & Flour)	8)									
Solvant	6	N.A.	-	N.A.	237	-	-	59 (One Fy.)	N.A.	296
Bakery	60	12	10	51	36	30	180	31	7	357
Soda Water	56	24	24	40	-	13	31	10	46	188
Ice Factory	11	7	12	9	6	12	8	-	4	58
Ice Candy	7	4	-	4	13	8	3	-	4	36
Cold Storage	2	-	-	-	-	-	17	-	6	23
-Ice Cream	2	-	-	-	-	-	10	-	-	10
Khandsari	1	-	-	9	-	-	-	-	-	9
Flour Mill	3	-	7	10	-	8	45	-	-	70
Spice	5	4	-	-	-	-	4	6	-	14
Misc.	5	-	-	-	-	-	62 (Copra Ind.)	9(Pro-tein Food)	-	71

SOURCE: Joint Director of Industries, Industries Office, Govt.of Maharashtra.

TABLE - 1-5

TOTAL INVESTMENT & PRODUCTION OF FOOD PROCESSING INDUSTRIES IN VIDARBHA (1972)

(Value in '000' Rs.)

	Land and Building	Plant and Machinery	Total Investment	Total Production
	26	27	28	29
Fruit & Vegetable	1620.0	1294.0	2914.0	6580.0
Rice Mill	4385.8	4613.0	8998.8	16891.0
Poha	387.4	310.1	697.5	2224.6
Dal & Flour	592.0	265.0	857.0	10695.4
Dal	6291.7	771.0	8435.7	37736.5
Solvant	5391.0	4560.0	12751.0	20200.0
Bakery & Conf.	150.2	321.8	539.5	3625.7
Soda Factory	744.5	997.0	221.3	1192.4
Ice Factory	234.0	588.2	863.2	372.87
Ice Candy	-	-	104.4	74.30
Cold Storage	513.67	241.0	754.7	100.0 (18251 Quintals)
Flour Mill	529.0	386.5	915.5	9011.5
Spices	25.0 (On-lease)	21.0	46.0	18.0
Misc.(Copra Unit, Protein Foods etc.)	15.44	778.8	99.23	1864.8

SOURCE: Joint Director of Industries, Industries Office, Government of Maharashtra, Nagpur.

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CHAPTER - 2

RAW MATERIALS

The principle food crops of the region besides cotton are wheat, jowar, rice, pulses and oil seeds. This region is also well known for Nagpur Santra. The region to a large extent depends on the monsoon for its agricultural production, and its economy is bes**t** with a single crop pattern. The district-wise area, production and yield per hectare of the principal crops grown in the region during 1973-74 are given at Tables 2-1, 2-2 and 2-3.

2.1 Cereals:

Out of the total area under food crops (31, 85, 955 Hect.), cereals occupy 76.5 per cent (24, 41, 642 Hect.). Amongst the cereals, jowar appears to be the major crop w**ith** 51 per cent of the area under cereals.

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Rice accounted for 23.7 per cent, wheat for 12.7 per cent, bajra for 6.3 per cent and maize, etc., for the remainder. Jowar and wheat are grown throughout the region. Rice is limited mainly to Bhandara and Chandrapur district and it is also grown in Nagpur, Akola, Yeotmal and Amraoti districts. Bajra is grown in Yeotmal, Akola, Buldhana and Amraoti districts. While Nagpur district leads in wheat cultivation, Chandrapur in rice, Yeotmal district leads in bajra cultivation. The yield of Jowar is highest (582 kg/Hect.) in Yeotmal district and lowest (328 kg/Hect.) in Bhandara district. Jowar Kharif crop gives better yield (405 kg/Hect.) than Rabi crop (361 kg/Hect.) on an average. The yield of rice is the highest in Chandrapur district (1,274 kg/Hect.) followed by Wardha (1,035 kg/Hect.), Bhandara (934 kg/Hect.) and Nagpur 925 kg/Hect.). While the yield of wheat is highest in Buldhana district (571 kg/Hect.), Nagpur, Yeotmal and Amraoti district had (510 kg/Hect) and in other districts the yield varied from 425 to 450 kg/Hect. The yield of Bajra is the highest in Nagpur district (500 kg/Hect.) and in other districts it is 280 to 286 kg/Hect.

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TABLE - 2-1

DISTRICTWISE DISTRIBUTION OF AREA UNDER DIFFERENT FOOD CROPS IN VIDARBHA
(1973-74)

(In Hectares)

Districts	Akola	Amraoti	Bhandara	Buldhana	Chandra-pur	Nagpur	Wardha	Yeotmal	Total Vidarbha
COMMODITIES:									
1. Jowar	2,32,410	1,70,661	33,269	2,55,813	2,04,144	2,01,152	1,32,340	2,59,586	14,8
2. Wheat	43,169	36,244	31,383	34,224	38,283	63,506	33,596	18,540	2,1
3. Rice	14,092	9,410	2,86,295	2,886	2,00,319	38,034	8,612	13,649	3,7
4. Bajra	15,299	10,602	-	12,906	159	206	1,374	16,774	5
5. Tur	36,763	40,054	6,999	24,442	12,328	39,851	28,618	44,784	2,3
6. Gram	12,960	8,753	12,510	5,484	13,060	10,587	4,289	6,366	7
7. Moong	24,665	-	-	29,417	-	-	13,721	23,732	9
8. Udid	43,231	-	17,522	33,056	-	-	-	15,136	1,0
9. Groundnut	26,484	30,317	1,369	25,740	337	13,190	6,661	41,551	1,4
10. Linseed	-	-	38,590	-	30,667	27,847	9,548	-	1,0
11. Sesame	-	-	-	-	50,719	-	-	5,374	5
12. Total Oil Seeds	43,301	44,075	41,195	67,971	82,094	65,690	24,531	55,553	4,2
13. Sunflower	-	-	-	35,137	-	-	-	-	3
14. Sugarcane	436	153	692	1,599	90	66	82	683	
15. Chillies	2,700	6,800	4,200	2,900	10,600	19,500	1,200	3,400	5
16. Ginger	-	100	-	-	-	-	-	-	
17. Garlic	100	-	-	-	-	-	-	100	
18. Turmeric	100	100	-	-	500	100	100	100	

1	2	3	4	5	6	7	8	9	10	
19.	Coriander	-	-	500	-	200	1,100	100	100	
20.	Oranges	300	5,700	200	200	100	7,600	1,900	200	1
21.	Potatoes	-	-	200	-	-	200	-	-	
22.	Onion	500	500	700	900	200	300	300	600	
23.	Brinjal	100	300	100	1,000	300	1,600	400	400	
24.	Tomato	100	-	200	100	100	1,700	200	100	2
25.	Radish	-	-	-	-	-	100	-	-	
26.	Bhendi	100	200	200	100	-	200	100	200	1
27.	Total Cereals	3,05,862	2,32,900	3,56,664	3,06,896	4,50,366	3,03,439	1,76,033	3,09,482	24,41
28.	Total Pulses	1,28,838	71,263	1,03,877	1,12,764	1,02,182	66,740	52,147	96,102	7,31
29.	Total Vegetable	800	800	1,400	2,100	600	4,100	1,000	1,300	12

SOURCE:- Socio-economic Review and District Statistical Abstract, Directorate of Economics and Statistics, Govt.of Maharashtra, Bombay.

TABLE - 2-1A

(In Hectares) AREA IRRIGATED UNDER FOOD CROPS IN 8 DISTRICTS OF VIDARBHA IN 1973-74

	Akola	Amraoti	Bhandra	Buldhana	Chandrapur	Nagpur	Yeotmal	Wardha	Vidarbha To
Jowar	-	-	71	809	233	126	-	9	1,248
Wheat	11,556	9,140	3,530	11,447	1,664	44,227	8,408	6,798	96,770
Rice	437	293	1,33,626	344	1,11,650	14,454	809	130	2,61,743
Bajra	-	-	2	21	-	-	-	13	36
Maize	-	-	-	219	84	-	-	-	303
Other cereal	-	-	-	6	-	-	-	-	6
Total cereal	10,518	9,484	1,37,244	12,846	1,13,661	28,827	9,231	6,953	3,28,764
Gram	247	1,328	2	876	-	1,660	145	255	4,513
Tur	-	-	-	-	-	-	-	10	10
Green gram	-	-	-	-	-	-	-	-	-
Black gram	-	-	-	-	-	-	-	-	-
Other pulses	-	-	-	19	-	-	-	-	19
Total pulses	248	1,411	78	895	42	1,718	145	286	4,823
Sugarcane	435	156	693	1,599	90	66	683	75	3,797
Chillies	1,525	2,037	1,799	1,374	402	1,052	1,458	591	10,238
Turmeric	53	71	-	5	474	52	53	23	731
Potato	15	10	172	22	11	106	29	15	380
Onion	471	-	690	-	183	-	-	-	1,344
Total Fruits & Vegetable	582	-	-	2,220	620	-	-	3,923	7,345
Total food crops	16,888	18,811	1,44,917	19,512	1,15,355	-	14,089	11,959	5,11,531
Groundnut	3	33	-	21	-	-	-	5	62
Oranges	-	-	139	-	-	6,829	135	-	7,103
Banana	-	-	-	462	-	-	165	-	627

SOURCE:- Socio-Economic Review and District Statistical Abstract, Government of Maharashtra, Bombay.

TABLE - 2-2

PRODUCTION OF DIFFERENT FOOD CROPS IN VIDARBHA (1973-74)

Production: in M.T.

Districts	Akola	Amraoti	Bhandara	Buldhana	Chandrapur	Nagpur	Yeotmal	Wardha	Total Vidarbha
Cereals:									
Jowar	1,03,700	94,000	12,100	1,44,900	97,000	92,000	1,66,300	63,600	7,73,600
Wheat	26,300	18,400	14,900	19,600	16,900	35,700	12,700	15,000	1,59,500
Rice	3,700	4,100	2,66,100	2,900	2,93,500	34,800	5,200	8,900	6,19,200
Bajra	2,800	3,000	-	4,600	-	100	5,600	400	16,500
Maize	100	200	300	600	900	-	-	-	2,100
Other cereals	200	2,000	1,100	-	1,200	-	200	-	4,900
Total Cereals	1,36,800	1,21,700	2,94,500	1,72,800	4,09,500	1,67,800	1,90,000	87,900	15,75,800
Pulses:									
Gram	7,100	3,900	4,700	2,000	4,100	3,800	2,600	900	29,100
Tur	24,700	32,300	3,400	17,400	5,100	19,100	42,200	22,800	1,67,000
Green Gram (Moong)	3,400	2,200	-	4,200	2,500	400	4,600	2,100	19,400
Black Gram (Udid)	5,700	600	4,400	7,800	2,600	100	2,400	-	24,600
Other Pulses	24,200	3,900	20,300	15,400	33,000	300	8,400	3,500	1,11,700
Total pulses	44,400	40,100	28,000	34,800	42,200	25,900	53,200	27,100	3,51,800
Total foodgrains	-	-	-	-	-	-	-	-	19,27,600

1	2	3	4	5	6	7	8	9	10
Oilseeds:									
Groundnut	13,600	19,600	1,300	9,000	100	7,100	15,700	3,300	69,700
Linseed	1,200	1,800	5,100	500	3,800	5,800	1,600	2,300	22,200
Seasame	1,000	800	200	500	10,600	6,000	1,500	1,300	21,900
Rape seeds	100	-	-	100	100	-	-	-	300
Total oil seeds (excluding cotton seed)	-	-	-	-	-	-	-	-	1,14,100
Spices:									
Chillies	-	8,600	1,100	2,600	5,800	4,200	700	2,900	25,900
Turmeric	200	100	700	-	700	-	-	100	1,800
Coriander	-	-	-	-	-	-	-	-	N.A.
Garlic	-	-	-	-	-	-	-	-	N.A.
Ginger	-	100	-	-	-	-	-	-	100
Total spice	-	-	-	-	-	-	-	-	22,100
Potato	-	-	-	-	-	-	-	-	1,800
Sugarcane (In term of Gur)	-	-	-	-	-	-	-	-	38,700

SOURCE:- Socio-economic Review and District Statistical Abstract, Directorate of Economics and Statistics, Government of Maharashtra, Bombay.

TABLE - 2-3

YIELD OF FOOD CROPS (1973-74)

Yield - Kgs/Hectare.

District	Akola	Amraoti	Bhandara	Buldhana	Chandrapur	Nagpur	Wardha	Yeotmal
Jowar	381	550	328	488	454	483	480	582
Wheat	444	508	421	571	442	509	446	510
Rice	446	436	934	104	1,274	925	1,035	437
Bajra	286	283	-	282	-	500	286	280
Gram	438	443	402	363	325	396	209	321
Tur	624	805	479	713	459	474	797	888
Green gram	-	173	-	-	-	-	153	189
Black gram	-	130	205	-	-	-	-	109
Maize	500	666	273	666	333	-	-	-
Groundnut Oil	624	646	-	494	333	490	493	606
Linseed	226	253	137	357	188	220	242	250
Sesame	278	186	286	277	210	306	200	214
Rapeseed	220	-	-	-	-	-	-	-
Chillies	-	143	234	530	483	208	538	674
Ginger	106	476	1,396	-	1,092	581	-	1,052
Turmeric	-	-	-	-	1,800	581	1,099	1,052
Sugarcane	6,833	7,000	6,833	687	7,000	-	-	6,833

SOURCE: - Socio-Economic review and District Statistical Abstract, Govt.of Maharashtra, Bombay.

The important varieties, seasons of sowing and harvest and average prices of the cereals are as follows:

TABLE - 2-4

VARIETIES, SEASONS OF SOWING AND HARVESTING AND AVERAGE PRICES FOR CEREALS

Commodity	Important varieties	Seasons		Prices
		Soving	Harvesting	Rs./Qunital
1. Jowar	Deshi and hybrid Thekedari	Kharif (Nov-Dec)		125-130
		Rabbi (March)		
2. Rice	White Luchai, Red Luchai	Kharif (Oct-Jan)		
		Paddy		
	IET-99, IR-22, Jaya, Sabarmati, Chinor, Ratna	Rice		205-250
	I-R-8, Tychung, Ludka and Eklombs.			
3. Wheat	Kalyan Sona, IR-65, Sonalika.	Rabbi (Oct-Jan)		125-170
4. Bajra	Deshi, hybrid	Kharif (Nov-Dec)		160
		June-July		

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2.2 Pulses:

Pu ses are cultivated in 7,31,913 hectares i.e. 20.15 per cent of the total area under food crops. The irrigated area under pulses is only 4,823 hectares. Tur is the main pulse of the region and the distribution of the pulses grown in the region is given in Table - 2-5.

TABLE - 2-5

DISTRIBUTION OF PULSES GROWN IN THE REGION (1973-74)

Pulse	Total acrage Hect.	% acreage of the total	Total production MT	% of total Production	Districts of major production
1. Tur	2,33,840	31.9	1,67,000	47.4	Yeotmal, Amraoti Akola & Wardha.
2. Black gram (Udid)	1,08,945	14.9	24,600	7.0	Buldhana, Akola & Bhandara.
3. Green gram (Mung)	91,535	12.5	19,400	5.5	Yeotmal, Buldhana & Akola.
4. Bengal gram	74,019	10.1	29,100	8.3	Akola, Bhandara, Nagpur & Amraoti
5. Other pulses	2,23,574	30.6	1,11,700	31.8	Chandrapur, Akola, Bhandara and Buldhana.
T o t a l	7,31,913	100.0	3,51,800	100.0	

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Acreage under tur in the five tahsils of Yeotmal district is in the range of 8 to 10 thousand hectares. In Amraoti district, Chandur, Amraoti and Achalpur share the area in the range of 8 to 9 thousand hectares, in Morshi and Daryapur it is 6,500 and 5,100 hectares respectively. In Akola district Washim taluka takes the lead (11,100 hect.) and in Mangrulpir, Akola and Murtizapur the area ranges from 5,500 to 6,500 hectares. In Wardha district it is in the range of 9 to 10 thousand hectares in Wardha, Arvi and Hinganghat talukas. In Buldhana district Mehakar and Chikhli talukas have an area of about 7 thousand hectares each and in Nagpur district, Ramtek and Nagpur talukas have an area of 12,200 hectares and 10,000 hectares respectively and in Umrer and Saoner talukas it is 7,900 and 5,800 hectares.

The acreage of more than 5,000 hectares in pulses other than tur is given talukwise in Table - 2-6.

Tur milling can be supplemented by green and black gram milling in Washim and Mangrulpir taluka in Akola, Wani and Darwha taluka in Yeotmal district, Mehakar and Chikhali, Malkapur and Khamgaon in Buldhana district, Wardha in Wardha district, Bhandara and Sakoli in Bhandara district.

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TABLE - 2-6

TALUKWISE ACREAGE (MORE THAN 5000 HECTARE) OF PULSES OTHER THAN TUR

Taluka	Pulses		
	Mung (Hect.)	Udid (Hect.)	Chana (Hect.)
Akola District:			
1) Akot	7,183	-	-
2) Washim	6,182	19,933	-
3) Mangrulpir	-	9,906	-
Yeotmal District:			
1) Wani	6,532	-	-
2) Darwha	-	7,304	-
3) Pusad	-	5,280	-
Buldhana District:			
1) Mehakar	23,588	10,144	-
2) Chikhali	5,713	8,267	-
3) Malkapur	-	5,611	-
4) Khamgaon	-	5,198	-
Wardha District:			
1) Wardha	6,273	-	-
Bhandara District:			
1) Sakoli	-	11,864	5,044
2) Bhandara	-	6,804	-

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The yield in kg per hectare of tur is the highest in Yeotmal district (883 kg) followed by Amraoti (805 kg), Wardha (797 kg), Buldhana (713 kg), Akola (625 kg), Bhandara (479 kg), Nagpur (474 kg) and lowest in Chandrapur district (459 kg). In regard to green gram (Mung), the yield in Yeotmal (189 kg) and Wardha districts 153 kg per hectare. The yield of black gram (Udid) is the highest in Bhandara (205 kg), followed by Amraoti (130 kg) and Yeotmal (109 kg), Amraoti district (443 kg) tops in the yield of Bengal gram per hectare 443 kg where as in Wardha district it is the lowest (209 kg).

The sowing and harvesting seasons of pulses, and their average wholesale prices are given in table - 2-7.

TABLE - 2-7

Pulses	Seasons		Price wholesale Rs./Qntl.
	Sowing	Harvesting	
Tur	June - July	Feb-March	380-400
Green gram (Mung)	Kharif (Aug-Sept)	Nov-Dec	320
Black gram (Udid)	Kharif (May-June)	Sept-Oct.	380
	Rabbi (Oct)	Feb-March	
Bengal gram	Rabbi	April-May	225-230

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2.3 Oil Seeds:

The area under oil seeds (excluding cotton seed) in Vidarbha was 4,24,410 hectares, yielding 1,14,100 M.T. in 1973-74. The important oil seeds of the region are ground-nut, (1,45,670 hectares yielding 69,700 M.T.), Linseed (1,06,642 hectares producing 22,200 M.T.), Seasame (56,093 hectare producing 21,900 M.T.) and Safflower (35,137 hectares).

The main groundnut belt of the region is made up of Yeotmal (41,550 hect.), Amraoti (30,317 hect.), Akola (26,484 hect.) and Buldhana (25,740 hect.). The production of groundnut in Amraoti district is the highest (19,600 tonnes) due to higher yields (646 kg/hect.) as compared to Yeotmal (606 kg), Akola (624 kg) and Buldhana (494 kg). The linseed belt comprises of Bhandara (38,590 hect.), Chandrapur (30,667 hect.) and Nagpur 27,847 hect.) districts. The production of linseed in Nagpur district is the highest (5,900 tonnes) due to higher yield by Bhandara (5,100 tonnes) and Chandrapur (3,800 tonnes). Cultivation of sesame is confined mainly to Chandrapur (50,790 hect.) and Nagpur (19,400 hect.) districts. Out of the total production of 21,900 tonnes of sesame, Chandrapur district accounts for 48.5 % (10,600 tonnes) and Nagpur 27.4% (6,000 tonnes). The average yield of sesame in Chandrapur is 210 kg/hect.

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and 306 kg/hect. in Nagpur district. Cultivation of Safflower is largely confined to Buldhana district.

Talukas having more than 5,000 hectares under groundnut are Darwha (15,860 hect.), Yeotmal (10,560 hect.), Pusad (8,034 hect.), Kolapur (6,108 hect.), Akola (6,108 hect.), Mangrulpir (6,609 hect.), Morshi (9,580 hect.), Chandur (7,512 hect.), Amraoti (6,260 hect.), Achalpur (5,169 hect.), Khamgaon (7,103 hect.) and Chikhali (7,907 hect.). Likewise for linseed the talukas are Bhandara (7,844 hect.), Gondia (22,037 hect.), Sakoli (8,709 hect.), Warora (14,249 hect.), Rajura (5,293 hect.), Umrer (11,543 Hect.), Ramtek (8,602 hect.) and Nagpur (6,837 hect.). For sesame cultivation, Warora (20,452 hect.), Chandrapur (12,376 hect.) and Rajura (10,308 hect.), are the main talukas. The season of harvest and average wholesale prices of the oilseeds are given in Table - 2-8.

TABLE - 2-8

YIELD PER HECTARE, SEASON OF HARVEST AND AVERAGE WHOLESALE PRICES OF OIL SEEDS

Commodity	Yield/Hect. in kg.	Season of Harvest.	Wholesale prices per quintal (Rs.)
Groundnut	333 - 646	Sept - Jan	430
Linseed	137 - 357	March	650
Sesame	186 - 306	Oct - Nov. Dec - Jan.	700

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The groundnut cake containing 6 to 8% oil obtained commercially as a by-product of the oil mills is at present sold as a cattle-feed or for use as a manure. It is also sold to solvent extraction units for recovery of the oil present in it and the deoiled cake is mainly exported. Based on the production of groundnut in the region (1973-74), the availability of commercial groundnut cake can be estimated at 24,800 tonnes. Groundnut is crushed in some oil mills without even removing the shells but generally the groundnut is decorticated before oil milling.

Shells constitute on an average30% by wt. of the groundnut. The estimated quantity of shells works out to 20,100 tonnes. The shells are used mainly as a fuel for burning purposes. The other oil seed commercial cakes are also used for the same purposes except sesame seed cake which is also used for human consumption to some extent.

2.4 Fruits & Vegetables:

The area under fruits and vegetables together in Vidarbha was 33,700 hectares (1972-73) and its district-wise break up in given at Table 2-9. Out of this, fruits covered 21,300 hectares (63.2%) and the rest was covered by vegetables.

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1	2	3	4	5	6	7	8	9	
Vegetables:									
Potato	-	-	200	-	-	200	-	-	400
Sweet potato	100	200	100	100	100	100	100	100	900
Onion	500	500	700	900	200	300	300	600	4,000
Carrots	-	100	-	-	-	-	-	-	100
Radish	-	-	-	-	-	100	-	-	100
Cabbage	100	100	200	100	100	300	100	100	1,100
Brinjal	100	300	100	1,000	300	1,600	400	400	4,200
Tomato	100	-	200	100	100	1,700	200	100	2,500
Bhendi	100	200	200	100	-	200	-	200	1,000
Fenugreek	-	-	-	-	-	-	100	100	200
Other vegetable crops	500	300	1,200	300	500	1,000	500	500	4,600

SOURCE:- Seasons and crops report Maharashtra State - 1972-73.

TABLE - 2-9

AREA UNDER FRUITS & VEGETABLE IN 8 DISTRICTS OF VIDARBHA (1972)

Area - (In Hectare)

1	Akola 2	Amraoti 3	Bhandara 4	Buldhana 5	Chandrapur 6	Nagpur 7	Wardha 8	Yeotmal 9	Total Vidarbha 10
Fruits:									
Santra	300	5,700	200	200	100	7,600	1,900	200	16,200
Other Citrus Fruits	100	100	-	-	-	100	100	-	400
Mosambi	-	100	-	-	-	400	-	-	500
Banana	200	400	-	500	-	100	600	200	2,000
Papaya	-	100	-	100	-	100	-	100	400
Other fruits	200	200	400	200	100	500	100	100	1,300
Total fruits	1,200	7,200	1,000	1,200	1,000	9,200	2,900	800	24,100
Mango	300	500	100	100	400	100	100	200	1,800
Guava	100	100	300	100	-	300	100	-	1,000

FRUITS:

Nagpur Santra:- The region is famous for its Mandarin oranges commonly known as 'Nagpur Santra', and predominates in its production. Introduction of Nagpur Santra in the region dates back to the end of the 19th century by Shri. Raghuji Bhonsale. The area under Nagpur Santra in the region district-wise is given in Table - 2-10.

TABLE - 2-10

AREA OF NAGPUR SANTRA IN VIDARBHA (1972-73)

District	Area in Hectares	% of total area
Nagpur	7,600	46.84
Amraoti	5,700	35.24
Wardha	1,900	11.73
Akola	300	1.85
Buldhana	200	1.24
Bhandara	200	1.24
Yeotmal	200	1.24
Chandrapur	100	0.62
T o t a l	16,200	100.00

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The average yield of Nagpur Santra is estimated to be 10 tonnes per hectare. On this basis the production of Nagpur Santra in 1972-73 was estimated to be 1,62,000 tonnes. Nagpur district leads (about 47%) in the acreage as well as production of Nagpur Santra, and it is closely followed by Amraoti district (about 35%). These two districts together with Wardha district contribute the bulk of Nagpur Santra in the region. In Nagpur district, Katol taluka occupies about 50% (3,328 hectares) of the total area under oranges in it. Saoner taluka is the runner up (1,633 hectares) of the district and Nagpur taluka itself occupies 1,265 hectares. In Nagpur district, Katol, Saoner and Nagpur are the three important places for Nagpur oranges. Saoner and Nagpur are in close proximity of each other. In Amraoti district Morshi taluka covers the bulk of Nagpur Santra followed by Achalpur taluka. Important centres for Nagpur Santra in Amracti district are Morshi or Warud and Amraoti.

In citrus fruits besides Nagpur Santra, other citrus fruits like Mosambi covered 500 hectares and other like limes 300 hectares. Mosambi is mainly cultivated in Nagpur district 400 hectares.

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2. Banana:- Area under Bananas in the region 2,000 hectares (1972-73) and its distribution in the districts was (i) Wardha (600) (ii) Buldhana (500), (iii) Amraoti (400), Akola (200), Yeotmal (200) and Nagpur (100). Selu in Wardha district and Malkapur taluka in Buldhana district are the major centres of Banana cultivation along with Morshi Taluka in Amraoti district. In Selu block alone the area covered under bananas has been estimated to be 1,000 hectares (1976-77) and the earlier variety has since been replaced by the Basrai variety. The rapid growth of Banana cultivation has been ascribed to the building of Bordam in the area. 22 banana plants are cultivated per acre in the area and each plant bears about 100 fruits. Thus Selu, Malkapur and Morshi/Warud are the important centres for Banana in the region.

3. Papaya:- Area under Papaya in the region was 400 hectares. 100 hectares each are shared in Buldhana, Amraoti, Yeotmal and Nagpur districts. Papaya is also grown all along the borders of Banana fields. The varieties grown are Cylone and Coimbatore.

4. Other Fruits:- The fruits covered are mainly Mango (deshi variety), Guava, Custard-apple, etc. The area under these fruits in the region was 1,700 hectares out of which the districtwise area shared is as follows:

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(i) Wardha (500 hectares), (ii) Nagpur (400 hectares), (iii) Buldhana, Akola and Amraoti (200 hectares each) and Yeotmal and Wardha (100 hectares each).

VEGETABLES:

The total area under vegetables was 12,400 hectares in 1972-73. Brinjal occupied the maximum area 4,200 hectares (33.9%), followed by onion 4,000 hectares (32.3%) and tomato 2,600 hectares (20.5%). The remaining area was covered by Bhendi 1,100 hectares (8.9%), Potato 400 hectares (3.2%) and Raddish 100 hectares (0.8%). Statistical data pertaining to green peas, cauliflower, cabbage, carrots, etc. are not maintained.

Brinjal is cultivated mainly in Nagpur (1,600 hect.) and Buldhana district (1,000 hect.) in other districts it is grown in the range of 100 to 400 hectares, Onion occupies 900 hectares in Buldhana, 700 hectares in Bhandara district, 600 hectares in Yeotmal district, 500 hectares each in Amraoti and Akola districts and in the remaining districts it is grown in the range of 200 to 300 hectares. Tomatoes are grown to the maximum extent only in Nagpur district and in other districts it is in the range of 100 to 200 hectares. Bhendi is grown in almost all the districts in about 100 to 200 hectares. Potato is grown in Bhandara and Nagpur districts, 200 hectares each.

The important source of Brinjal and Tomatoes happens to be Nagpur district and for onions Buldhana, tops the list.

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2.5 Spices:

The area covered under spices like chillies, ginger, garlic, turmeric and coriander totals to 54,600 hectares in the region, in 1972-73. Chillies alone occupy 51,300 hectares (93.9%), Coriander 2,000 hectares (3.66%), and turmeric 1,000 hectares (1.83%). The districtwise distribution of spices in 1973-74 is given in Table 2-11.

TABLE - 2-11

DISTRICTWISE DISTRIBUTION OF SPICES (1973-74)

District	Area (Hectares)					Yield of chillies kg/hect.	Production Tonnes	
	Chillies	Coriander	Turmeric	Garlic	Ginger		Chillies	Turmeric
Nagpur	20630	1100	100	-	-	208	4200	-
Chandrapur	12000	200	500	-	-	483	5800	700
Amraoti	6030	-	100	-	100	143	8600	100
Bhandara	4720	500	-	-	-	234	1100	700
Yeotmal	1040	100	100	100	-	674	700	-
Buldhana	4920	-	-	-	-	530	2600	-
Akola	-	-	100	100	-	-	-	200
Wardha	5380	100	100	-	-	538	2900	100
T o t a l	54720	2000	1000	200	100		25900	1800

Nagpur district is the main centre for chilly and coriander. Chandrapur district is for turmeric. Ginger has been introduced to a considerable extent in Amraoti district. The yield of chillies in Chandrapur, Yeotmal, Buldhana and Wardha district was more because of the introduction of hy-brid variety (Jwala). The yield of ginger in Amraoti district was 476 kg per hectare, and it was reported to be double in Chandrapur, Bhandara and Yeotmal districts.

The yield of turmeric in Chandrapur district was the highest (1800 kg/hect.), Wardha district 1099 kg., Yeotmal district had 1052 kgs; and it was 581 kgs in Nagpur district.

In Vidarbha, the important centres for chilli are Umrer, Bhiwapur, Paratwada, Chandur bazar, Hinganghat, Nagpur, Amraoti, Dhamangaon, Daryapur, Ramtek, Malkapur. The centres for turmeric are Samudrapur, Shendurjanaghat, Morshi and for ginger they are Achalpur and Shirasgaon. The seasons and wholesale prices of the spices are given in Table 2-12.

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TABLE - 2-12

SEASONS AND WHOLESALE PRICES OF FRUITS, VEGETABLES & SPICES

Fruits/ Vegetables/ Spices	Harvesting Seasons	Wholesale prices Rs.
Fruits:		
Orange	Ambia - Oct - Nov	600/Cart
	Mrig - Feb - April	
Banana	July- Sept	20 to 70 per 1000 fruits
Mango	April - May	
Papaya	Feb - May	
Guava	Nov - Jan	
Vegetables:		
Brinjal	May - August	40 - 70/quintal
Onion	Feb - March	74 - 90 "
Tomato	Nov - Feb	50 - 100 "
Potato	Dec - Jan	120 - 140 "
Bhendi	Jan - Oct	50 - 75 "
Spices:		
Chillies	Nov - Feb	565 - 900 "
Turmeric	March	480 - 740 "
Ginger	Nov	200 "
Garlic	-	250 - 300 "

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Sugarcane:

The area under sugar cane in Vidarbha in 1972-73 was 3,801 hectares and the estimated production was 38,700 tonnes. The acreage in Buldhana district was the highest (1,599 hectares) followed by Bhandara (692 hect.), Yeotmal (683 hect.), Akola (436 hect.), and Amraoti (153 hect.). In other districts it ranged from 66 to 90 hectares. The yield of sugar cane was about 3 to 4 tonnes per hectare. Rate of sugar cane was about Rs.125/tonne and the season spans the period November to April. The important centres are Dusarbid, Pusad, Dharni, Karanja, Selu, Navegaon, etc. The use of land and agricultural production in Vidarbha at a glance can be seen from Table - 2-13.

The average yields of Agricultural production in Vidarbha as compared to Bombay and Poona Division of Maharashtra are given in Table - 2-14.

The States average yield of rice decreased from 1,041 kgs/hect. in 1971-72 to 586 kgs in 1972-73 or by 45 per cent. It was due to the adverse season during the year 1972-73. Similarly the yield of wheat also decreased from 506 kgs to 253 kgs in 1972-73 or by 30 per cent.

2.7 Fisheries:

Information regarding fisheries in Vidarbha region (1975-76) is given in Table - 2-15.

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TABLE - 2-13

USE OF LAND AND AGRICULTURAL PRODUCTION IN VIDARBHA (1973-74)

Main crops	Acreage (Hectares)	Production (Tonnes)
Jowar	14,89,375	7,73,600
Rice	5,73,297	6,19,200
Wheat	2,98,945	1,59,500
Bajra	57,330	16,500
Tur (Red gram)	2,33,839	1,67,000
Udid (Black gram)	1,08,945	24,600
Mung (Green gram)	91,535	19,400
Chana (Bengal gram)	74,019	29,100
Groundnut	1,45,669	69,700
Linseed	1,06,642	22,200
Sesame	56,093	21,900
Horticultural Crops:		
Oranges	16,200	1,65,000
Chillies	54,720	25,900
Sugarcane	3,801	15,204

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TABLE - 2-14

AVERAGE YIELD OF PRINCIPLE CROPS OF NAGPUR DIVISION (VIDARBHA) AND POONA AND BOMBAY DIVISION OF MAHARASHTRA (1972 - 73)

Commodity	Nagpur Divn., (Vidarbha) yield kg/ Hect.	Bombay Division Kg/hect.	Poona Division Kg/hect.
Jowar - a) Kharif	405.1	531.7	300.6
b) Rabbi	361.3	275.3	96.8
Rice - Kharif	416.7	861.6	503.3
Wheat	381.7	436.8	563.5
Bajra	184.0	170.3	201.2
Maize - Irrigated	712.5	907.3	863.0
Un-Irrigated	207.6	337.2	219.0
Red gram (Tur)	519.6	294.3	207.0
Black gram (Udid) - Kharif	153.5	210.0	131.1
Black gram (Udid) - Rabbi	171.3	191.0	-
Gram	270.0	227.6	243.2
Green gram (Mung) - Kharif	125.5	167.4	102.3
Green gram (Mung) - Rabbi	149.7	230.0	-
Groundnut (Pods)	280.8	295.4	292.9
Linseed	172.2	177.0	93.8
Sesame - Kharif	154.75	135.8	118.0
Sesame - Rabbi	178.7	181.0	-
Chilli - Un-Irrigated	256.9	284.2	100.2
Chilli - Irrigated	800.0	926.1	694.5
Turmeric - Irrigated	1,119.5	901.0	1,135.7
Ginger - Irrigated	990.5	755.6	571.0
Sugar cane (in terms of gur)	5,580.0	9,339.0	9,408.0

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TABLE - 2-15

VIDARBHA FISHERIES AT A GLANCE (1975 - 76)

Resources:	
1) Total length of rivers	4,900 km
2) Total length of perennial rivers	2,592 km
3) Total water spread area	80,000 Ha
4) Area suitable for fish culture (Ponds, lakes, reservoirs, etc.)	54,000 Ha
5) Area brought under fish culture	45,500 Ha
6) Total No.of tanks	26,250
7) Total No.of perennial tanks	1,120
Manpower:	
1) Total population of Vidarbha as per 1971 Census	116.73 lakhs
2) Fishermen population:	87,360
(a) Full time fishermen	7,600
(b) Part time fishermen	11,400
3) No.of fishing boats (Non-mechanised mostly dug-outs)	720
Production and Preservation:	
1) (a) Fish production 1975-76	4,500 M.T.
(b) Fish production from riverine sources	900 M.T.
(c) Fish production from tanks	3,600 M.T.
2) Value of catch to producers	Rs. 1.35 crores
3) No.of ice factories (Private) Capacity 169 tonnes	11
4) No.of cold storages - Government	1
(Capacity 826.5 M.T)- Private	6

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Cooperation:

1) No. of fishermen Co-operative societies			211
(a) Primary Societies membership			16,699
(b) Divisional Federation			1
(c) District Federation			2
2) Share capital (Primary)		Rs.	4,36,014
3) Financial assistance: For purchase of fishery requisites 1975-76.			
Fish Seed & Pisciculture	i) Loan	Rs.	20,186-71
	ii) Subsidy	Rs.	1,73,652-97
Nylon	Subsidy	Rs.	1,04,025-53
	Nylon twine	Rs.	2,803-540

Total waterspread area available at fish farms:

	Area	Nos.
1) No.of fish seed farms in operations (Kelzar, Bor, Seonibandh, Saikheda)	5.60 ha.	4
(a) Fish Seed farms under construction at Itiadoh, Nagthana, Maregaon, Pus, Katepurna, Baslapur.	9.82 ha.	6
(b) Fish Seed Farms under consideration (Pench, Ambhora, Chargaon, Amalnallah, Mandwa, Isapur).	-	6

2) Production of fish seed	1975-76	345.45 lakhs
(Upto 8/76	1976-77	320.37 lakhs
3) Import of fish seed	1975-76	309.0 lakhs
	1976-77	322.76 lakhs

Fisheries Education:

a) One month fishermen training course at Nagpur.	15 Nos.
b) Nine month fishermen training in inland fisheries at Agra.	4 Nos.

More than100 candidates trained uptill now in 1 month training course.

Total receipts:	1975-76	Rs. 7,79,675-37
Total Plan Outlay	1975-76	Rs. 14.72 lakhs.

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CHAPTER - 3

POST HARVEST TECHNOLOGY

Post-harvest technology plays a crucial role in the Agricultural marketing of foods. After the food commodities are harvested, the food has to be prepared in the form in which it is needed generally by the consumer. Depending upon the food commodity the post-harvest technology involves a number of stages like, curing, threshing, winnowing, drying, milling, grading, storage, packing, transportation and market distribution, etc. The post-harvest technology therefore, plays a vital role in minimising food losses caused by biological agents, physico-chemical changes and environmental conditions like temperature, humidity, etc. and offering wholesome and nutritious food to the consumers. This field of activity is steeped in traditional methods which have

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emerged through years of experience, and are therefore not only economical but also difficult to be replaced in the existing context. This field offers wide scope for improvements basically for qualitative as well as quantitative aspects. Identifications of these areas and suggesting improvements or remedial measures is the main object in this field of activity. The existing practices in regard to important food commodities grown in Vidarbha are briefly outlined.

31. Cereals:

Amongst the cereals, jowar is the largest produce and is considered to be the staple food of the people in the region.

Jowar (Sorghum vulgure):

After curing for 4-5 days in the field so as to reduce the moisture content from 20 to 16%, the grains are separated from jowar heads by trampling the earheads under the feet of bullock or running a stone roller over them or metal disk threshers. The chaff and extraneous matter are separated by winnowing either by hand or machine. It is further sun-dried by spreading them on the ground and then equilibrated in heaps so as to attain a moisture content of 10 to 12%. It is reported that about 10 to 15% grain is wasted during these operations.

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It is then transported in bulk mainly by bullock carts for storage. In villages it is stored in bamboo and mud bins (Dholi) of varying sizes and capacities. Dried neem leaves are put on the top and the container (Dholi) is plastered with a mixture of mud and cowdung to prevent ingress of insects. A trap door is provided at the base of the bin for withdrawing the grain when needed. For marketing, they are packed in gunny bags. About 10% losses during storage are quite common. The areas which require improvements can be identified as (1) optimum moisture content the grain for threshing, (2) suitable thresher, (3) optimum moisture for storage, (4) improvement in sun-drying to minimise field losses, (5) suitable bulk storage containers, (6) fumigation of the grain for bulk storage and treatment for house-hold storage, (7) improvement in packaging both for bulk sale and retail sale, (8) construction of rural ware-houses for community storages, (9) Pearling for improvement in nutritive value, (10) improvement in traditional milling (chakki) and fractionation of milling products, (11) Enrichment of Kadba (Sorghum fodder) for feed purposes (availability of Kadba 50,46,048 Tonnes), (12) Malting of Jowar or stocks, and (13) manufacture of Poha.

Rice:(Oriza Sativa)

Harvesting and threshing conditions have a considerable effect on the quality of harvested grain. Determina-

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tion of the optimum stage for harvesting, threshing, storing and milling is mostly emperical in the region. The crop is harvested while the straw is still somewhat green. Slow drying of the sheaves before threshing leads to better milling quality. Moisture content of the grain at harvest and methods adopted for drying before threhsing and storing are said to have a considrable effect later on the milling quality of rice. The variety of rice also plays an important part in these matters. The traditional practice in Chandrapur district is as follows. Immediately after harvest the paddy is cured for 15 to 25 days in the field. Then threshing is done. Threshed paddy (moisture content 20 to 22% is stored in bins (Dholies) and is used for milling when it is needed. The optimum moisture content for milling is about 15 %. If the paddy is exposed to sunrays for drying, the breakage of the grain is more during milling. It is reported that about 15% paddy is lost during storage in dholi perhaps due to higher moisture content. The two most common threshing practices are (1) beating the sheaves against a hard surface, (2) allowing the sheaves to be trodden by animals. A pedestal thresher (cap.100 kg.paddy/hr.) and a power thresher (1H.P. cap.270 kg.paddy/hr.) and tractors hired on contract basis are also used. Winnowing of paddy is done by hand or by power thresher. An average peasant -or land holder stores usually ½ to 1 tonne of paddy for

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his use and at a time only 100 to 300 kgs of paddy are milled and not the entire stock, because milled rice under rural storage conditions has a keeping quality of only 3 to 4 months. The labourer who gets his wage in the form of paddy, mills only about 50 kgs to meet his requirements. The paddy is processed by (1) hand pounding, chakki or similar equipment (2) hullers available in the village or nearby village or town. As parboiling of paddy is not practised, the proportion ofpaddy milled by hullers or shellers is larger than that processed by hand-pounding. It is said that a labourer prefers to sell his paddy to merchants and buys rice to avoid heavy labour involved in hand pounding of raw paddy. Some mechanical milling facility to handle small amounts of paddy is needed to meet the requirements of the labourers. Milling season in the region starts in October and lasts upto May. November to February is the peak milling season. The milling charges are Rs.3.50/quintal for a rubber roller mill and Rs.3/quintal for other mills.

Storage:

Rice is packed in gunny bags for storage. Since old rice fetches more price, storage of rice is important. If paddy is properly dried (moisture below 9%) and stored in a dry place, it keeps almost indefinitely. When rice is stored in bags, about 10 to 15% losses are reported due to

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rodents, insects and fungal damage. Hand-pounded or under milled rice spoils rapidly.

The areas which can be identified for improvement are (1) Determination of optimum moisture for threshing and milling of important varieties grown in the region, (2) Appropriate threshers and cleaners for paddy, (3) Minimise wastage in paddy during storage, (4) Improvements in milling yield by adopting modern milling technologies, (5) Improvements in drying of paddy after threshing, (6) Provision of facilities for milling small quantities of paddy either through improved method of hand-pounding or improved mills, (7) Stabilization of bran for retention of quality, (8) Utilisation of other by-products like husk and broken rice, (9) Introduction of parboiled rice, (10) Improvements in bulk as well as house-hold storage of rice, (11) Improvement in machinery for manufacture of Poha for better yield and quality.

Wheat:

When 75 % of the plant population turns yellow it is considered to be ready for harvest and the moisture content of the grain is about 10%. After harvesting it is spread on threshing floor and trampled under the feet of bullocks; and winnowed by hand. It is stored in bulk in slit bamboo containers plastered with mud. Sizeable portion (70 %)

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is retained by the growers in villages for their consumption and the rest is packed in gunny bags and sent for marketing. About 10 % is lost during storage due to insect infestation, and infection of the microflora present. It is estimated that 2,96,400 tonnes of wheat straw is available annually; which is used as cattle feed. It is suspected that about 45 to 50 % of this waste is digested by the animals. Wheat is generally consumed in the form of atta. The products of roller flour mill are atta, maida and soji (obtained from endosperm 84-85 %), bran (13 to 14 %) and germ (2 to 3 %).

The post harvest handling of wheat has the following problems:

(1) Semidwarf variety like Sonalika, Sarbati Sonora are susceptible to nitrogen levels and location, and these long with the traditional varieties give products of wide variation in quality; and due to this the supply to the baking industry is not of uniform quality. The baking process has to be frequently altered and the quality of improvers, extenders and stabilizers have to be varied to obtain a uniform standard baked product. (2) Varieties grown in the region should be categorised for their suitability for the manufacture of bread, biscuits and chapati. (3) Techniques such as (i) conditioning and milling, (ii) air classification of flours for evolving

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blended flours need investigation with a view to obtaining baked products of uniform quality. (4) Systematic work has to be carried out to ascertain the efficiency of chakki, milling quality of products and their suitability for baked goods. Heat damage caused by excessive heat -in the chakki in regard to its nutritional quality has to be assessed. (5) Utilization of wheat germ obtained as a by-product in roller flour mills. (6) Minimise losses in storage of wheat. (7) Improvements in the digestibility of wheat straw for feed purposes.

3.2 Pulses:

Food grains happen to be the main constituent (80%) of the diets of the population in India. Cereals constitute the main source of calories, proteins, vitamins and minerals. Pulses are traditionally used in a variety of Indian food preparations, and are rich sources of lysine in which cereals are deficient. The supplementation of cereals with pulses is essential for balancing the vegetarian diets. Legumes therefore form a special feature of the Indian diet.

Tur dal (Cajanus cajan) constitutes the major legumes of the region. The other legumes grown are green gram, black gram and bengal gram. The minor pulses like, lakh, matthi, etc. are also grown.

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The first harvesting of legumes is usually done by hand picking. At the final harvest the plants are cut as near the ground as possible, and are tied into bundles. The bundles are then taken to threshing floor and stacked on end for a few days. When the leaves and pods are nearly dry, the pods are separated by vigourously shaking the plants or by beating with a wooden flail. The fallen material is beaten or trampled upon by bullocks. The seeds and chaff are separated by winnowing. The seeds are thoroughly dried in the sun and stored after cleaning in earthen ware or metal receptacles.

The legumes have an outer protective layer called husk, which is not considered suitable for edible purposes, as they contain tannins, pigments and bitter substances. The primary purpose of processing is the removal of husk to make them edible. The dehusking method can be a dry, wet or semi-moist operation. The principle involved in these operations is essentially an application of physical abrasion. Methods have also been devised for removing the husk by toasting, drying, and softening with oil. The seeds are split into dal before marketing.

The milling is done mostly in hand mills or chakkies, power mills have also recently come into use.

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The professional dal makers act as middle men between cultivators and consumers and often control the price and distribution of the product. The dry de-husking method is followed in the region for dal making. In this method the seeds are exposed to the sun for three to four days and then split in a mill. The seeds are sometimes smeared with a small quantity of vegetable oil (gingelly or castor oil) to soften the seed coat and facilitate the milling. The unsplit seeds are removed, treated with oil, dried in the sun and milled again. This fractional milling is repeated three or four times till all the seeds are split into halves. The husk of pods and seeds constitutes a valuable cattle feed. Mixed with broken bits and powder of dal, the husk is sold under the name chuni for feeding milch cattle. In the traditional milling there is more breakage and powdering of grains resulting in lower yi lds.

The recently developed technology for improving yield consists in the conditioning of pulses followed by de-husking and spliting of dal in specially designed units. All these operations are independent of climatic conditions, less expensive and much quicker than the traditional operations.

The areas which need improvement can be identified as:

1) Drying of pods and seeds.
2) Traditional milling for higher yields.
3) Utilization of dal bits and powder as a protein supplement.

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TABLE - 3-1

THE YIELD OF DALS BY TRADITIONAL AND IMPROVED MILLS

Legume	Botanical name	Traditional method	*Improved method
1. Pigen Pea or Tur	Cajanus Cajan	72%	87%
2. Green gram	Phaseolus radiatus	65%	85%
3. Black gram	Phaseolus mungo	71%	85%
4. Chick Pea or Channa	Cicer arietinum	75%	85%

* Bench scale data from C.F.T.R.I., Mysore.

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3.3 Major Pests:

Major pests of stored foods with their scientific as well as common name are given in Table 3-2.

TABLE - 3-2

MAJOR PESTS OF STORED FOODS

Scientific name	Common name	Commodities commonly attacked
1	2	3
1. Sitophilus oryza L	Rice Weevil	Wheat, rice, jowar, corn, macaroni, synthetic rice, tapioca chips, etc.
2. Rhizopertha dominica F.	Lesser grain borer	Broken cereals, wheat, rice, sorghum, pulses, corn products, macaroni, etc.
3. Trogoderma granaria Everts.	Khapra beetle	Broken cereals, wheat, barley, malt foods, dhal (split pulses) soji and broken pulses.
4. Tribolium castaneum Herbist	Rust red flour beetle	Milled materials of cereals, pulses and oil seeds, processed foods and confectionery.
5. Oryzaephilus surinamensis L	Saw toothed grain beetle	Oil seeds, dry fruits, confectionery, fruit candy, maida, nuts, flour, oilseed cakes.
6. Terebroides mauritanicus L	Cadelle or yellow meal worm	Cereals-wheat, sorghum and rice.
7. Stegobium paniceum L	Spice beetle (orient) Biscuit beetle (continent) drugstore beetle(West)	Spices, confectionery, processed foods and drugs.

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1	2	2
8. Lasioderma Serricornis F.	Cigarette beetle	Tobacco, processed leaves cigarettes, cigards, variety of spices & drugs.
9. Laemophloeus minutus Olive.	Flat grain beetle	Broken grain, cereals, pulses, oil seeds and deteriorating processed foods.
10. Araecerus fasciculatus de Geer	Coffee bean weevil	Coffee, stored cocoa bean areacanuts, tapioca chips, banana chips, cotton seeds and leguminous seeds with high moisture content.
11. Callosobruchus chinensis L.	Pulse beetle	Stored whole pulses, Bengal gram, green gram, field beans, other legumes.
12. Sitotroga cerealella Oliv	Paddy moth or Tropical ware-house moth	Paddy, sorghum (Ears) in fields.
13. Plodia interpunctella. Hubn.	Indian meal moth	Food grains.
14. Echestia cautella Walker	Almond moth	Oil seeds, currant raisins, dried apples, Berries, figs almons, walnuts, pistachio, chocolates, biscuits, tamarind seeds, garlic, broken cereals and broken pulses.
15. Corcyra cephalonics	Rice moth	Rice, other broken cereals, oil seeds and processed foods.
16. Alphitobius piceous olive	Black fungus beetle	Mouldy food stuffs.
17. Latheticus oryzae (Waterh)	Long headed flour beetle	Wheat, rice, corn, barley, rye, flour, dried vegetable material.
18. Attagenus piceus Oliv	Black carpet beetle	Jute bags, fibres, foods stored in gunny bags, carpets and wooden material.

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1	2	3
19. Carpophilus dimidiatus F.	Corn sap beetle	Botting and decaying fruits, and vegetation, damp and decaying grains, in rice mills.
20. Gibbium psyll oides Fab. P.	Hump beetle	Cereal cakes, yeast, wheat, dry bread, cotton seeds, pay paste and papriba.
21. Caryeodon gonagra	Groundnut bores	Undecorticated nuts, legume seeds
22. Alasverus advena Waltl	Foreign grain borer	Damp grain and seeds.
23. Necrobia rufipes	Red-legged ham beetle	Dried fish, copra, cocoanut cakes.
24. Calandra linearis	Tamarind weevil	Tamarind seeds and legume pods.
25. Sitophilus Zea-maia	Corn weevil	Rice, sorghum, corn.

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3.4 Oil Seeds:

Amongst the oil seeds grown in the region, groundnut (Arachis linn.) is the most important crop. Other major edible oil seeds are linseed, sesame, and cotton seed.

When the groundnut crop reaches maturity, leaves begin to wither and turn yellow. The development of a distinct tint inside the shell is also an indication of maturity. Harvesting is done by pulling out the plants. The pods after drying are removed by hand or beating the plants against a bar. The pods are dried soon after harvesting to prevent deterioration. The cultivators sell their produce mostly as nuts in shell. A major portion of groundnut is used for oil extraction by the milling industry either after decortication or as such.

Sesame (Sesamum linn.) is harvested when the leaves of plant turn yellow and start drooping and capsules are slightly yellowish. The harvested plants are piled in circular stacks with root end outwards and the capsules are allowed to dry by opening the stacks and spreading them out during day and restacking during night. When all the capsules are dry, the seeds are removed by inverting and shaking the bundle of plants on the threshing floor, and the remainders are removed by light beating with a stick. The seeds are collected and cleaned.

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Oil mills produce oils as the main product and oil cakes as a valuable by-product. On the basis of production of oil seeds in Vidarbha (1973-74) it is estimated that 25,600 tonnes of groundnut cake and 11,000 tonnes each of linseed and sesame cakes, totalling to 47,600 tonnes are produced annually. The oil cakes have a ready internal as well as export market. These however constitute a rich source of proteins and can be used for the preparation of protein foods for human consumption. Each of the oil cakes presents characteristic problems, before it is rendered fit for human consumption as a source of edible protein. High grade edible cake meals such as groundnut, sesame and cotton seed have been obtained after removing the toxic factors. The edible meal or cake obtained as a by-product contains about 50% protein and about 6% residual oil and is a suitable base for development of protein rich products acceptable to consumer at low price. The main problem here is non-utilization of this cake as a source of vegetable proteins for edible purposes.

3.5 Fruits & Vegetables:

Fruits and vegetables are essential ingredients of a balanced human diet. These constitute protective foods as these are rich sources of vitamins and minerals. Per-capita consumption of fruits is quite less in the Country.

They are seasonal in nature, and have to be preserved for their availability throughout the year. Though Nagpur Santra is produced to the extent of 1,65,000 tonnes, a fractional portion (about 2000 tonnes) of the same is used for processing in the region.

M/s. Chocs and later NOGA Nagpur have since its inception in 1946, been doing pioneering work for processing and canning of Nagpur Oranges as well as other fruits and vegetables. A small scale unit started by a food technologist in his orchard has also set an example in this field. With the availability of irrigation facility, cultivation of fruit like banana and vegetables is increasing. If one goes by the dictum "eat what you can and can what you can't" Nagpur Santra alone stands for it at present. However, there is a growing awareness to produce these commodities to an extent where their processing can be economically feasible. The direct linking of horticulture with the processing industry is a "sine quinon" for its growth, and the horticulture must be developed to produce varieties of these commodities which are suitable for canning and processing to avoid competition with table fruits in the market. In view of the present position, post-harvest technology of Nagpur Santra and banana are dealt with. In other cases the names of varieties suitable for canning/processing and areas having potential for their growth are indicated.

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Nagpur Santra:

Mature oranges are hand picked by twisting and pulling and collected in a cloth sack tied round the neck of the pickers. These are then spread in a few layers on Tmas matting. The fruits are sorted and graded by hand, -if these are to be packed in wooden cases in the orchard itself. Usually, the fruits are loaded loose in bullock cart and brought to the market or to the packing sheds. When the oranges are brought to the market they are spread on the ground in layers and auctioned. Since, the fruit is a delicate living matter, great care is required during its picking, handling and transportation. Any bruise or injury to the fruit during these stages is likely to result in losses due to decay, etc.

Grading and Standardization:

In market or in the packing sheds Nagpur Santra is graded in 4 grades, based on the size as big, medium, small and damaged or defective. Commercially, they are known as mondha, mal, thulli and chura respectively. The sizes of the grades are:

Grade	Size (Diameter equatarial)
1. Mondha	7.00 cms. & above
2. Mal	5.7 to 7.00 cms.
3. Thulli	Below 5.7 cms.
4. Chura	Damaged or defective fruits.

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Packing:

The commercial packing of Nagpur Santra comprises of a wooden case (533 mm length, 330 mm breadth and 330 mm height) with tanas as the cushioning material and news paper as lining along the sides in the case. The number of fruits packed in it varies according to the size of the fruit, etc., while grading. Oranges packed in traditional packing cases suffered losses to the extent of 40 per cent during long distance transport to places like Mysore and Delhi, due to physiological break-down as well as decay. An improved ventilated wooden packing case of the same size as that of the commercial use as well as a cardboard carton were evolved by the Institute to minimise the losses during transport of oranges to long distance as well as export. Paper pads containing tanas (dry grass) were used to avoid contact of tanas directly with fruits with advantage.

Assembly and despatches:

The average despatches by rail from Nagpur alone during 1971 were estimated to be 62,700 tonnes. Besides this about 70 to 80 tonnes of oranges per day were also despatched by road to different centres from Nagpur. Other important centres of despatches and its statewise break up is given in Table - 3-3 and 3-4.

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TABLE - 3-3

ESTIMATED AVERAGE ANNUAL DESPATCH OF [illegible] FRO. NAGPUR TO DIFFERENT STATES

Sl. No.	Importing Centres	Approximate quantity in quintals	Percentage
1.	Delhi	35,000	13.21
2.	Punjab	25,000	9.43
3.	Madras	15,500	5.85
4.	Andhra Pradesh	15,500	5.85
5.	Bihar	15,500	5.85
6.	Uttar Pradesh	24,500	9.25
7.	Gujarat	13,000	4.92
8.	Madhya Pradesh	8,000	3.02
9.	Orissa	2,000	0.75
10.	West Bengal	74,500	28.11
11.	Maharashtra	32,500	12.26
12.	Other States	4,000	1.50
	T o t a l	2,65,000	100.00

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TABLE - 3-4

ANNUAL DESPATCHES OF NAGPUR ORANGES FROM RAILWAY STATIONS NEAR ABOUT NAGPUR

Sl. No.	Name of Station	No.of Wagons* despatched
1.	Kalmeshwar	141
2.	Kohli	103
3.	Katol	121
4.	Kalameha	162
5.	Narkher	406
6.	Multapi	764
7.	Teegaon	58
	T o t a l	1,755

* One wagon holds about 149 quintals (gross)

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Trials of treated as well as un-treated oranges packed in traditional and improved wooden packaging case as well as cardboard carton to distant out stations like-Mysore, Calcutta and Delhi were carried out for assessing the extent of losses. The improved wooden case and use of paper pads in between the layers as well as cardboard carton were found functionally superior to traditional packaging practice. The oranges treated with 5 per cent waxol containing 500 ppm Benlate 50, was also found to be most successful treatment for transport of oranges in improved wooden case as well as cardboard carton.

Export:

Export of Nagpur Santra picked up during 1975-76, mainly to Iran and Dubai and 200 tonnes packed in cardboard cartons or plywood ventilated crates were exported during this period. The rate per tonne was Rs.1,250/- at the orchard. In the Ambia season (1976), 1006 tonnes of santra were exported to Iran and Dubai. This amounts to only a small fraction of the total production of the Santra in the region. As a trial lot about 10 tonnes of oranges treated with fungicidal wax emulsion were included in the export consignments to Iran and Dubai. It was reported that treated oranges suffered little spoilage as compared to the un-treated consignments, where the spoilage was high, and were thus preferred.

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Wastage:

The wastage due to the decay (fungal spoilage) occurs both in the orchard as well as in the other stages of marketing. The extent of total wastage is reported to be about 20 % during handling and transportation, etc.

Effect of fungicides and other treatments for minimising decay:

Nagpur Santra (Ambia crop) have very short storage life upto 8 days at ambient temperature. With a view to extending their post harvest life during storage by reducing spoilage and improving their marketability, investigations were carried out to identify the organisms associated with the decayed fruits and further to study the effect of various fungicides, growth regulators and hot water treatment in controlling decay in fruits.

Seven organisms causing decay of santra were isolated and only six were identified. These were (1) Phytophthora citrophthora (Brown Rot), (2) Gloeosporium follicum, (3) Alternaria citri (stem end rot), (4) Geotrichum candidum (Sour rot), (5) Pencillium species (Blue & Green) and (6) Aspergillus niger (Black rot).

Post harvest treatment of santra consisting of an instant dip in wax emulsion (developed at C.F.T.R.I., Mysore) at 6 per cent concentration containing 0.1 %

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Benlate-50, or 2,500 ppm of Tecto-60, fungicide had increased the static storage life of santra from 8 to 20 days. However, pathogens causing, sour, brown and stem end rots could not be effectively controlled. Pre-harvest treatment with suitable insecticides and fungicides, may therefore prove helpful. Preliminary investigations in regard to the pre and post-harvest fungicidal and other treatments have been carried out and further work in these regards has been envisaged.

Cost Benefits:

A preliminary transport trial to Delhi by rail wagon of consignment of 25 cases and 31 cartons was carried out to assess the economic benefit of the wax coating treatment and the improved container. Delhi merchants revealed that the economic benefit ranged from Rs.5/- to Rs.8/- per case depending on the size grade of the fruits and market prices and introduction of carton will meet the long felt need of replacing the wooden cases. The fungicidal wax coating treatment of santra has been tried extensively by few orange growers in the region for the last three years or so and they have reported it to be economically beneficial.

Utilization:

The culls are fruits which are otherwise sound for processing but are bruised, spotted, injured, softened,

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without calyx, irregular shape, over and under size and blemished, etc. The culls cannot withstand transport over long distances and have to be utilized for processing before they are spoiled. The culls are sold at a nominal price as they cannot be sold as table fruits. If efforts are made to collect the culls at suitable centres from the adjoining areas, these can constitute a cheap raw material for the processing industry, without competing with the fresh fruit. If a co-ordinated effort is made to organise the collection of culls which are an inevitable part of the primary orange growing industry, there will be a bright future for the orange processing industry in Nagpur and Amraoti districts of the region. The proportion of culls in Italy is commonly as high as 30 per cent of the total crop. In Palestine it is 15 % and in California where the cultivation methods are superior to those in general use, the proportion of culls is normally much lower probably only 10 per cent. A realistic assessment of culls in Nagpur and Amraoti district is absolutely essential before any place for setting up new orange processing units are considered. Ways and means of their collection, quick transport to the processing unit have to be simultaneously determined. A price agreement and delivery schedules will have to be made between the growers, traders and the processors for building up of this industry.

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Orange Products:

The golden yellow mandarin orange (Santra) is an all useful fruit and lends itself for processing into a number of products. The flowers, twigs and leaves may yield the essential oils such as the oil of Neroli and mandarin petitgrain oil. The orange peel which constitutes 25 per cent of the fruit contains about 2.5 per cent essential oil called orange oil. It is a valuable by-product and is used for flavouring purposes in foods, pharmacauticals, etc. A Triple Roller Extractor has been designed and fabricated for the extraction of orange oil from the peels. The Triple Roller Extractor (CFTRI) has a capacity to handle about 2 quintals of peels per 8 hours shift and the oil recovery is 55 per cent on the fresh peel basis. The quality characteristics, as well as the yield is better than the commercial extractors used presently in the region.

The oranges of Ambia crop are generally sour in taste with sugar/acid ratio around 10-15 as compared to oranges of mrig crop which are relatively sweeter with sugar/acid ratio of 20 to 25. The ambia is considered to be the major crop of the two (60:40) in normal seasons. Because of the chemical characteristics, the seed position in the segments and the prices, Ambia santra is preferred for processing and canning.

Orange juice is the major product of the orange processing industry. The yield of the juice varies from 40 to 50 per cent depending upon the method of extraction and purpose for which it is to be used. The juice on storage, however, turns bitter. The method of extraction plays a vital part in minimising its bitterness. The acceptable level of bitterness according to western standards is 6 to 8 ppm of limonin content in the juice. Bitterness of orange juice posed a problem for its acceptance in the country. The Central Food Technological Research Institute, Mysore has developed a Citrus Juice Extractor, which was otherwise to be imported, to overcome this difficulty. The method of lye peeling of segments is also used but it affects the quality of the juice by dilution. Bulk preservation of the juice with a chemical preservative is done in wax lined barrels to be used subsequently. Orange juice is extensively used as a base by the fruit preservation industry for the manufacture of popular orange products like squash, crush, fruit syrup, ready to serve orange beverage, jams and marmalades. Sweetened orange juice (85 %) is either canned or bottled. To economize on the packing and transport, orange juice is concentrated four fold or six fold under vaccum and packed in 4 kgs. cans or preserved in the barrels. The concentrated juice can be reconstituted to natural juice by diluting it with water.

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A ready to serve orange beverage as well as a carbonated orange drink (containing orange juice) have been prepared at the CFTRI, Experiment Station, Nagpur.

Orange juice is rich in vitamin 'C' and 100 gms. of juice on an average contains 25 to 30 miligrams of the vitamin which is the normal daily requirement. In advanced countries of the world it is customary to start the breakfast with a glass of orange juice. A blend of orange with mango and pine-apple juice is also packed for different tastes. The pomace and the spent peel can be used as a cattle feed. The dried and powdered peel is also used as a filler by the soap industry. The pomace and the peels together also constitute a source of pectin. A process for the manufacture of pectin from peels, etc. has been developed by C.F.T.R.I., and for the release of its know-how, NRDC, New Delhi may be contacted. The albedo portion of the fruit is reported to be a source of vitamin 'P'. Canned orange segments in syrup have also been exported to U.K. and some European Countries.

The quantity and value of orange products manufactured in various states in India are given in Table 3-5.

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TABLE - 3-5

QUANTITY AND VALUE OF ORANGE PRODUCTS IN 1970

States	Orange Products	
	Quantity in tonnes	Value in (000' Rs)
Andhra Pradesh	174	520
Assam	116	301
Bihar	3	15
Gujarat	2	8
Haryana	-	1
Himachal Pradesh	2	8
Jammu & Kashmir	1	3
Kerala	64	176
Madhya Pradesh	-	1
Maharashtra	826	3281
Manipur	6	21
Meghalaya	15	77
Mysore	1467	5376
Nagaland	4	16
Orissa	16	69
Punjab	98	329
Rajasthan	1	4
Tamil Nadu	30	71
Tripura	3	17
Utter Pradesh	561	2461
West Bengal	55	228
Union Territories:		
Chandigarh	18	60
Delhi	21	67
Goa	19	55
T o t a l	3502	13165

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TABLE - 3-6

ESTIMATED PRODUCTION OF ORANGE PRODUCT IN 1970

Sl. No.	Product	Quantity (Tonnes)	Value (000' Rs)
1.	Canned		1
2.	Jam	52	263
3.	Jelly	1	4
4.	Marmalades	299	1602
5.	Juice	497	1191
6.	Pulp	2	7
7.	Squash	2617	10020
8.	Syrup	1	10
9.	R.T.S. Beverages	53	67
	T o t a l	3502	13165

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It will be seen from this table that orange squash is the most popular product followed by orange juice and marmalade.

Future Scope:

For development of horticulture, processing industry which helps to utilise fruits which though sound but cannot stand transport and could otherwise be wasted is a necessary adjunct. The industry at present is salvaging a very small percentage of these fruits. Depending upon the availability of culls, it may be possible to establish small units in Nagpur and Amraoti districts. Processing of tomatoes can be taken up by these units for diversification of the product as well as their economic working.

In the growing region small Feeder Units for the manufacture of semi-finished products can be set up. The equipment and machinery/processes may be prototype, but modified/improved on modern scientific lines with emphasis on quality to meet their requirements.

This will help in establishing viable central units to process the semi-finished products of the network of Feeder Units into finished products and also undertake the manufacture of valuable by-products like pectin,

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terpeneless orange flavour and feeds, etc. It will not only meet the long and actually felt need of establishing a citrus processing industry in the region but will also lead to its rapid development due to its direct link with the growers.

Banana:

When the fruits become light green in colour and plumpy, the banana bunches are cut, and sent for ripening. The banana hands are separated from the bunch and heaped in a closed room for ripening. Ripening is induced by smoking for 36 to 48 hours and then stored in well ventilated godowns for 2 to 3 days. On an average 20% fruits are spoiled during post-harvest handling, transportation, and marketing.

In Selu Panchayat Samiti Block the ripening of bananas is not done. There is wastage of banana during rainy season due to transport difficulties as pucca roads are not available. The fruits are marketed in green raw form. The markets for Selu banana are Nagpur, Gondia, Jabalpur, Rajnandgaon, etc. Pseudostems are cut into small pieces and are at present used as a manure. The tender inner portion of the stem can be marketed as vegetable. Papaya is cultivated on the border lines of banana fields to act as wind breakers.

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The main difficulties are (1) improvements in roads and marketing facilities (2) utilization of pseudostems for industrial purposes.

Pulpy fruit like banana grown in the area can be converted into clear fruit juices by enzymic action. The clarified banana juice can be bottled and marketed; like the apple juice. This will enable to save the wastage of sound ripened banana particularly in the rainy season. Most of these problems can be over come by organising a growers co-operative marketing and processing society in the Panchayat Block. Along with banana, papaya can also be utilized for papain and papaya candy from raw papaya. For minimising the wastage of banana during handling and transport, due to microbial attack, fungicidal spray/dip and paste can be applied.

The varieties of fruits and vegetables suitable for canning/processing as well as the areas in Vidarbha having potential for their growth are indicated in Table - 3-7.

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TABLE - 3-7

Fruit/Vegetable	Varieties suitable for canning/ processing	Areas with potential for growth
1. Tomatoes	Red top, Ruth, Early chathum Sunmarzano, Best of all	Nagpur district, Pusad in Yeotmal district, Amraoti district.
2. Green Peas	K.Wander,Bombay green Yales early crop, S. Supreme, A.Wonder, Blue Banthaun, Khaparkheda.	Nagpur district, Pusad in Yeotmal district, Amraoti district.
3. Papaya	Cylone, Coimbatore	Akola district, Saoner in Nagpur district, Amraoti district.
4. Mango	Totapuri, Baiganpally	Pusad in Yeotmal district.
5. White Onions with high total soluble solids	To be decided in consultation with ICAR.	

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Seedless Oranges:

Seedless variety of mandarin oranges is necessary for manufacture of canned orange segments which have a large demand in export markets. Propagation of seedless variety of orange like the Japanese is a long standing need of the region. To meet the same, work has already been initiated at the Regional Fruit Research Station at Katol. So far 56 varieties of mandarin and tangerin have been collected and observations of these varieties in respect of growth and fruiting under our conditions are being made. To find out the best root stock combination for Nagpur Santra, 42 root stocks have been collected and their performance is being studied over the last seven years or so. The findings of these studies, may, therefore, be awaited.

3-6. Spices:

Chilli is the major spice of the region. Turmeric grown in the region is known after its place of initial cultivation - Waigaon. Other spices like coriander, garlic, onion, are grown in areas where irrigation facilities are available. Ginger is also attracting attention as a cash crop and its belt is Shirasgaon in Amraoti district.

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Chillies:(Capsicum annum Linn)

Chillies are harvested during December to February at weekly intervals and brought to market in bullock carts. Chillies are marketed as fresh red chillies at Bhiwapur (about 80% in Umrer and Bhiwapur markets) and as dry (about 12%) in Nagpur market. Remaining 8% of the produce is retained by the growers for house hold consumption and seed purposes. The wet red chillies are purchased by the traders and sun-dried on plots taken on rent.

In the traditional method fresh red chillies are dried in the sun by spreading on the ground in single layer with frequent turning over and then stacked in heaps. Depending on the initial moisture content (usually 74%) the process takes 15-21 days to dry the chillies to about 15-20% moisture content. This method is unhygienic, time consuming, and gives lower yield of dried product due to loss of seeds by breakages and gives lower yield of dried product due to loss of seeds by breakages and causes fading of colour during storage, making the product unattractive. Also in this method the turnover of material and capital is slow.

CFTRI has developed an improved technology for sun-drying of chillies which has several advantages over the traditional method.

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For quicker drying of chillies, a demand has been voiced to develop a mechanical dryer by the Zilla Parishad, Nagpur. To meet this demand bench scale studies on fluidized bed drying of chillies have been completed; and its operation has been demonstrated to the number of chilli growers. Its scaling up work can be taken up by CFTRI as a sponsored project. Chillies contain 58-60% pericarp, 30-32% seeds and 7.5 to 8.5 % stems. The seeds also contain edible oil to the extent of 9 to 11%. Its quality is dependent on the red colour and pungency. A process to extract oleoresin (extract of colour, oil and pungency) has been developed by CFTRI and the same has been released to a Nagpur Firm through NRDC for setting up of a tonne/day plant in the Hingna Industrial Estate.

Turmeric (Curcuma longa):

When the lower leaves turn yellow, the crop is ready for harvest and the rhizomes are dug up by hand picks. The bulbs and finger parts are separated; and long fingers which command higher price in market are broken into convenient bits. After removing the dirt and fibrous roots, the rhizomes are subjected to a process of curing and polishing. The process of curing involves cooking the rhizomes in water containing a few leaves of turmeric until they become soft. The cooked rhizomes are allowed to cool gradually and are then spread out in the open to dry. They are turned over intermitently to ensure uniformity in drying. The polishing consists of rubbing the dried

rhizomes on a rough surface (gunny bags) to remove the outer skin for giving them an attractive colour. Sprinkling of water during polishing is said to improve the colour. Depending upon the quality and ripeness of the raw tuber, the yield of dried product ranges from 17 to 25% of the fresh material. The poorly developed red branches of the rhizome are separated, cut into pieces, and utilized without curing for preparing KumKum.

In the Samudrapur block turmeric is grown in about 10 Hect. located in adjoining Narayanpur, Govindpur and Waigaon villages. The irrigation is provided from a tank situated in a elavated area. A few families have owned this land which is now fragmented into small pieces; due to inheritance. The ownership of the tank has changed hands and the dispute about it is yet to be settled. Because of the prevailing circumstances, there is no development, though the quality of the turmeric grown there is considered to be the best.

Ginger (Zingibar officiale):

Ginger is harvested when the leaves turn yellow and stems begin to dry and lodge on the ground. For finding out optimum harvest time for ginger CFTRI has carried out trials at Agricultural Research Station, Ambalavayal, and found that if Rhizomes are allowed to

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remain underground for a long period they turn fibrous. The optimum time of harvest was found to be between 245 to 260 days after planting. Similar trials in this region will also have to be conducted

The varieties of ginger suitable for making a dehydrated product are "Rio-de-Janeir" and "China". These varieties should be propagated in the region. CFTRI has also developed a process for the preparation of Oleoresin from ginger.

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CHAPTER - 4

CHEMICAL COMPOSITION, NUTRITIVE VALUE AND POSSIBLE TOXICOLOGICAL INFORMATION ON THE RAW MATERIALS

4.1 Functions of Food:

The food, we eat every day, contains the following dietary essentials: (i) proteins, (ii) fats, (iii) carbohydrates, (iv) mineral salts, and (v) vitamins. Food nourishes the body in the following ways:

1) It provides the body with fuel, such as fats and carbohydrates, which are oxidised and supply the energy required for various activities.

2) It provides proteins for the building and upkeep of the body tissues.

3) It furnishes vitamins and minerals by means of which the life processes in the body are regulated, thereby protecting against ill health.

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Functionally, foods are classified as:

i) Energy yeilding foods:- Foods rich in carbohydrates and fats are called energy yielding foods. Cereals, roots and tubers, dried fruits, sugars and fats are included in this group. Cereals contain, in addition, fair amounts of protein, minerals and certain vitamins and form the important sources of the above nutrients particularly in poor dietaries.

ii) Body Building foods:- Foods rich in proteins are called body building foods. Milk, meat, fish, eggs, pulses, oilseeds, nuts and low-fat oilseed flours are included in the group of body building foods.

iii) Protective foods:- Foods rich in proteins, vitamins and minerals are termed protective foods. Milk, eggs, liver, green leafy vegetables and fruits are included in this group. Protective foods are broadly classified into two groups: (a) foods rich in vitamins, minerals and proteins of high biological value, e.g., milk, eggs, meat, fish and liver and (b) foods rich in certain vitamins and minerals only e.g., green leafy vegetables and fresh fruits.

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4.2 Role of proteins, fats, carbohydrates, minerals and Vitamins in Nutrition:

Proteins:

Proteins are required for promoting growth and for the building and upkeep of the body tissues. In addition, they are necessary for the production of metabolic and digestive enzymes, blood proteins and hormones. Deficiency of proteins in the diet of adults results in loss of weight, reduced resistance to infection and oedema. Prolonged deficiency of proteins in the diet of children results in a condition known as Kwashiorkor characterised by general weakness, emaciation, reduced resistance to infections, oedema and dry (lustreless) skin with pigmentation.

Proteins differ from one another in their nutritive value and may be broadly classified into three groups:

i) Complete proteins (Proteins of high nutritive value). These proteins can promote good growth in children and young experimental animals e.g., proteins of milk, eggs, meat, fish, liver, etc.

ii) Partially complete proteins (Proteins of moderate nutritive value). These proteins promote only moderate growth in children or young experimental animals but they can meet the protein requirements of adults e.g., proteins of cereals, millets, pulses, nuts and oilseeds.

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iii) Incomplete proteins (Proteins of very low nutritive value). These proteins cannot promote any growth in young rats nor can meet the protein needs of adults e.g., gelatin.

Fats:

Fat along with carbohydrates in the food serves as a source of energy and is also stored in the body beneath the skin. Fat in the diet serves as a carrier for the fat-soluble vitamins and is also essential for the absorption of carotene (pro-vitamin A). Fat also supplies the essential fatty acids which are needed by the body. Prolonged deficiency of fat in the diet may cause dryness of the skin.

Carbohydrates:

Carbohydrates serve as the main source of energy to the body. When consumed in excess they are converted into fat and stored in the body. Carbohydrate deficiency in the diet does not occur except in times of food shortage.

Minerals:

The minerals present in the diet play an important role in nutrition:

i) as constituents of the mineral matter of the bones.

ii) as structural constituents of the soft tissues and

iii) as constituents of physiological active substances e.g., iron in haemoglobin concerned in regulatory functions.

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The more important minerals are Calcium, Phosphorus and Iron.

Calcium & Phosphorus:- Both calcium and phosphorus form the major constituents of bones and teeth and are essential for their formation. Both are present as soluble salts in all the fluids of the body and supply the necessary electrolytes for the action of muscles and nerves. In addition, calcium participates in the coagulation of blood. A deficiency of calcium in the diet causes rickets and decay of the teeth.

Iron:- Iron is mainly required for the formation of haemoglobin which is an important constituent of the red blood cells. Prolonged deficiency of iron in the diet causes anaemia.

Vitamins:

These are present in very minute amounts in different foodstuffs and are essential for growth and health. The most important of the vitamins are:

Vitamin A & Carotene, Vitamin D, Vitamin B_1(Thiamine), Vitamin B_2(Riboflavin), Nicotinic acid, Vitamin C(Ascorbic acid), Folic acid and Vitamin B_{12}.

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Vitamin A & Carotene:- Vitamin A is essential for the integrity of epithelial tissues and is a stimulus for new cell growth. It is necessary for maintaining the eye in healthy condition and for proper vision in dimlight. A continued dificiency of this vitamin in the diet causes night blindness, reduced resistance to infection, phrynoderma or toad skin, xerophthalmia (dryness of the conjunctiva of the eyes), Bitot's spots (greyish patches on the white of the eye) and keratomalacia (opacity of the cornea).

Carotene is a precursor of vitamin A and is present in large quantities in green leafy vegetables, tomatoes, carrots and some fruits.

Vitamin D:- Vitamin D increases the absorption of calcium and phosphorus and regulates their concentration in the blood. It directly helps in the formation of hard and healthy bones and teeth. Deficiency of vitamin D causes rickets in children and osteomalacia in adults.

Vitamin B_1 (Thiamine):- Vitamin B_1 plays an important part in carbohydrate metabolism. It is essential for the maintenance of good appetite and normal digestion. It is also required for the normal functioning of nerve tissues. A milk deficiency of this vitamin in the diet results in

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loss of appetite and digestive disturbances. Prolonged deficiency of this vitamin causes the disease known as beri beri.

Vitamin B_2 (Riboflavin):- Vitamin B_2 is concerned in the metabolism of carbohydrates, proteins and fats. A deficiency of this vitamin causes burning sensation of the eyes, inflammation of the tongue, dimness of vision and fissuring at the angles of the mouth (angular stomatitis).

Nicotinic acid (Niacin):- Nicotinic acid takes part in the metabolism of carbohydrates, fats and proteins. Severe deficiency of this vitamin causes a disease known as pellagra, characterised by soreness of mouth and tongue, diarrhoea and dark pigmentation of exposed parts of the body.

Vitamin C (Ascorbic acid):- Vitamin C is necessary for the maintenance of good health. It also hastens the healing of wounds and bone fractures. Deficiency of this vitamin in the diet causes the disease scurvy which is characterised by tender, swollen and bleeding gums; bleeding into the skin and joints; anaemia and delayed healing of wounds and bone fractures.

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Folic Acid:- Folic acid stimulates the formation of red and white blood corpuscles. Deficiency of folic acid in the diet results in the development of macrocytic anaemia. This disease commonly occurs in pregnant and lactating women. Important sources of folic acid are whole cereals, pulses, nuts, green leafy vegetables and liver.

Vitamin B_{12}:- Vitamin B_{12} is identical with the antipernicious anaemia factor occurring in liver. It stimulates the formation of red blood cells. Deficiency of this vitamin causes macrocytic anaemia. This disease commonly occurs in pregnant women subsisting on ill-balanced diets. Vitamin B_{12} occurs only in foods of animal origin eg., liver, mutton, fish, egg, milk and curds

4.3 Nutritive Value of different groups of foods:

The nutritive value of different groups of foods is given in Table - 4-1 and is briefly discussed below:

Foods may be broadly classified into ten groups based on their nutritive value: (i) cereals and millets, (ii) pulses, (iii) nuts and oil seeds, (iv) vegetables, (a) green leafy (b) non-leafy (c) roots and tubers, (v) fruits, (vi) milk and milk products, (vi) animal foods-meat, fish, liver, egg, etc., (viii) fats and oils,

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(ix) carbohydrate foods, (x) condiments and spices. The nutritional significance of the different groups of foods is briefly described below:

Cereals and Millets are the most important of food-stuffs consumed throughout the World. They are rich sources of carbohydrates and fair sources of proteins (6-12 per cent). In India cereals and millets contribute 70-80 per cent of the calories, proteins and certain B-vitamins and minerals in the diets of the people. All cereals except ragi are poor to moderate sources of calcium. Rice is the poorest of all in calcium content. Ragi is a rich source of calcium.

Pulses are rich in proteins containing about 18-25 per cent. They are also good sources of B-vitamins and minerals. Germinated pulses, and tender pulses like green peas, grean bengal gram and green field beans are good sources of vitamin C.

Nuts and Oilseeds are in general (except coconut) rich sources of protein containing about 18-28 per cent. They are also rich sources of fat and good sources of minerals and B-vitamins. Gingelly (sesame, til) seed is particularly rich in calcium. Groundnut and soyabean can be used for the preparation of vegetable milk and curds.

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TABLE - 4-1

FOOD GROUPS AND THEIR DESCRIPTION AND NUTRITIONAL IMPORTANCE

Food group	Foodstuffs	Nutritional importance
1	2	3
I. Cereals and millets	Rice, wheat, bajra, ragi, maize, etc.	Rich sources of carbohydrates, fair sources of proteins (6-12 %) & B-vitamins and certain minerals.
II. Pulses	Bengalgram, blackgram, greengram, redgram, peas, beans Masur dhal, etc.	Rich sources of proteins (18-25%), certain B-vitamins and minderals.
III. Nuts and oilseeds	Groundnut, sesame seeds, cashewnuts, almonds, walnuts, soyabean, etc.	Rich sources of protein (18-28%), fat (20-60%), certain B-Vitamins and minerals.
IV. Vegetables:		
a) Green leafy	Amaranthus, cabbage, coriander, drumstick, radish, spinach, etc.	Rich sources of carotene (pro-vitamin A), vitamin C, calcium and iron.
b) Non-leafy	Brinjal, beans, cauliflower, ladies fingers, pumpkin, snake gaurd, ash gourd, plantain, etc.	Fair sources of vitamin-C and minerals.
c) Roots and tubers	Potato, tapioca, sweet potato, carrot, radish, colocasia, yam, etc.	Good sources of carbohydrates which can be used as partial substitutes for cereals.
V. Fruits	Amla, guava, papaya, lemon, orange, banana, mango and tomato.	Good sources of vitamin C and some of carotene also.

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1	2	3
VI. Milk & Milk products	Milk and Curds	Good sources of all nutrients and the most complete of all foods.
VII. a) Animal foods	Mutton, liver, kidney, fowl, fish, etc.	Rich sources of protein, (18-22%), B-vitamins and phosphorus.
b) Eggs	Hen's & Duck's	Rich source of protein (13%), vitamins and minerals.
VIII. Carbohydrate foods	White and brown sugars, jaggery, honey, sago, arrowroot flour and corn flour (custard powder).	These serve mainly as source of energy.
IX. Fats & Oils	Groundnut oil, cocoanut oil, gingelly oil, butter, ghee, vanaspati, etc.	Concentrated sources of energy. Sources of fat soluble vitamins especially vitamin E. Some (butter, ghee and vanaspati) also contain vitamin A.
X. Condiments and spices	Chillies, tamarind, etc.	These have carminative properties and increase the palatability of foods.

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Vegetables:- Green leafy vegetables are very rich sources of carotene, which is a precursor of vitamin A. They are also good sources of calcium, riboflavin, folic acid and vitamin C. They are the cheapest among the protective foods.

Non-leafy:- This group includes all vegetables other than those included in the above category. Some of them are fair sources of vitamin C and minerals.

Roots and tubers are good sources of carbohydrates and can be used as partial substitutes for cereals in the diet. Some of them are also good sources of vitamin C. Carrots and yellow flesh variety of sweet potato are rich sources of carotene also.

Fruits in general are good sources of vitamin C. Some of them (mango and papaya) are also moderately rich sources of carotene. Indian gooseberry (amla) and guava are very rich sources of vitamin C. Other good sources of vitamin C are tomato, citrus fruits, papaya, mango and pineapple.

Milk and Milk Products:- Milk is universally regarded as an ideal food for nourishing infants and young children. It is also good supplementary food in the diet of adults.

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Milk is the most complete of all foods, containing the different nutrients in the proper proportions. It is, however, deficient in iron and contains only small amounts of vitamins C and D.

Whole milk powder is about 8 times as rich as fresh milk in all nutrients except vitamin C. When reconstituted with 7 times its weight of water the reconstituted milk has almost the same composition as that of fresh milk.

Skimmed milk powder is rich in proteins, calcium and B vitamins but is dificient in fat and vitamins A & D and hence it is not suitable for feeding infants. It can, however, be used as a supplement to the diets of children and adults.

Sweetened condensed milk:- This is about 2½ times as rich as fresh milk and contains in addition about 45 % cane sugar. It is not suitable for feeding infants as it contains too much of sugar. It may however, be given as a supplement to the diets of children and adults.

Animal Foods:- Liver is rich in proteins (18-20 %) of high nutritive value and vitamin A and B-Complex. It is the richest natural source of vitamin B_{12} the anti-pernicious anaemia factor.

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Meat is rich in proteins of high biological value. It is also a fair source of B-vitamins.

Fish is also rich in proteins of high nutritive value. It is a fair source of B-vitamins. Large fish are rich in phosphorus but are deficient in calcium. Small fish, eaten with bones, are good sources of calcium.

Hen's egg is a highly nutritious food containing about 13 per cent protein of high nutritive value and 13 % fat (rich in lecithin). It is also a rich source of vitamin A and B-vitamins. It is fair source of vitamin D but does not contain vitamin C. Egg white contains only protein and B-vitamins while egg yolk contains protein, fat and vitamin A, B-Complex and D.

Fats and Oils serve mainly as sources of energy. Ghee, butter and vanaspathi contain about 750 I.U. of vitamin A per ounce. All the vegetable oils and fats used for edible purposes do not contain vitamin A but are good sources of Vitamin E.

Carbohydrate Foods commonly used are cane sugar, jaggery, glucose, honey, syrup, arrow root flour, sago, etc. They serve mainly as sources of energy. Honey contains in addition to sugar small quantities of minerals and vitamins.

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Condiments and spices are commonly used to enhance the palatability of foods. The essential oils present in them have carminative properties and aid in the digestion of food by stimulating the appetite and the secretion of digestive juices.

The food values of different groups of foods are given in Table - 4-2 and 4-3.

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TABLE - 4-3

CHEMICAL COMPOSITION OF WHEAT PRODUCTS

(Values per 100 g)

	Protein (g)	Fat (g)	Fibre (g)	Carbohydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin B_1 (mg)	Nicotinic acid (mg)
Whole wheat flour	11.8	1.5	1.2	71.2	0.050	0.320	5.3	0.54	5.0
White flour (70-72% extraction)	10.2	0.8	0.2	74.8	0.015	0.106	1.5	0.12	1.2
Semolina (Suji)	10.4	0.8	0.2	74.8	0.016	0.102	1.6	0.12	1.2
White bread	7.8	0.7	0.2	51.9	0.011		1.1	0.04	0.7
Brown bread	8.8	1.4	1.2	49.0	0.018		2.2	0.21	2.5
Chemical composition of rice (%):									
Raw husked rice	7.7				0.015	0.368	4.0	0.40	3.5
Raw, undermilled or home-pounded rice (about 7% polishings removed)	7.2				0.013	0.146	2.2	0.22	2.2
Raw, milled rice (about 14% polishings removed)	7.0				0.010	0.110	2.0	0.11	1.0

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Chemical composition, essential amino acids content and possible toxicological information on important raw materials is given below:

SESAME (Seasamum indicum)

Chemical composition:

Protein %	..	18.3
Fat %	..	43.3
Carbohydrate %	..	25.2
Calcium %	..	1.4

Essential amino acids (g/16 g N):

Lysine	..	2.6
Methionine	..	2.9
Cystine	..	2.0
Total S-A.A.	..	4.9
Tryptophan	..	1.5
Threonine	..	3.0

Use:- The seed is mainly processed for oil. The cake obtained from dehusked seed is pleasant to taste and can be used for edible purpose. Sesame meal has been used in many processed protein formulations for treatment and prevention of protein d ficiency status.

SAFFLOWER (Carthamus tinctorius)

Chemical composition (g%):

Protein	..	12.5
Fat	..	27.2
Carbohydrate	..	44.0
Calcium	..	0.06

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Essential amino acids:

P.E.R. .. 1.6 at 10% level

Use:- The seed is processed for oil. The meal obtained from dehusked seed contains 32-35% protein of fairly good quality.

LINSEED (Linum usitatissimum)

Chemical composition:

Protein %	.. 20.3
Fat %	.. 37.1
Carbohydrate %	.. 28.8
Calcium %	.. 0.17

Essential amino acid (g/16 g N):

Lysine	.. 3.1
Methionine	.. 1.5
Cystine	.. 1.9
Total S-A.A.	.. 3.4
Tryptophan	.. 1.6
Threonine	.. 3.5
P.E.R.	.. 1.9 @ 10% level

Use:- The seed is processed mainly for oil. The linseed cake contains 40-42% protein of fairly good quality.

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MUSTARD (Brassica Juncia)	RAPE SEED (Brassica campestris)

Average chemical composition (g%):

Protein	..	22
Carbohydrate	..	24
Fat (ether extractives)	..	39
Mineral matter	..	4
Fibre	..	1.8

Essential amino acids (g/16 g N.):

Lysine	..	4.4
Methionine	..	1.5
Cystine	..	1.3
Total S-A.A.	..	2.8
Tryptophan	..	1.8
Threonine	..	3.4

Use:- The seeds are processed for oil and the cake is used to a limited extent as cattle feed and the rest as manure. To obtain edible quality protein from the cake, it should be freed from pungent and toxic principles.

GROUNDNUT (Arachis hypoges)

Chemical composition:

Protein g %	..	26.7
Fat g	..	40.1
Carbohydrate g	..	20.3
Calcium	..	0.13
Minerals	..	1.9

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Amino acid composition (g/16 g N):

Lysine	..	3.52
Methionine	..	0.96
Cystine	..	1.44
Total S-A.A.	..	2.40
Tryptophan	..	1.12
Threonine	..	2.72
P.E.R.	..	2.0 @ 9% level

Uses:- This is an important dry crop of the World and is a good source of oil. In India it is roasted and eaten with jaggery or fried and salted. The oil-cake obtained is valuable food for cattle and manure. It is rich in nitrogen than other oilcakes. Edible oilcake is the most important protein source in India. A new industrial use for groundnuts has been the manufacture of textile fibre or artificial or synthetic wool under the name 'Ardil' from the protein of groundnut.

PEA (Pisum satiya)

Chemical composition:

Protein %	..	19.7
Fat %	..	1.1
Carbohydrate %	..	56.5
Calcium %	..	0.07

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Essential amino acids (g/16 g.N):

Lysine	..	7.3
Methionine	..	1.2
Cystine	..	1.3
Total S-A.A.	..	2.5
Tryptophan	..	1.1
Threonine	..	3.8
P.E.R.	..	1.1 @ 10% level

Use:- A legume mainly used for soup preparations.

SOYABEAN (Glycine mix)

Chemical composition:

Protein %	..	43.2
Fat %	..	19.5
Carbohydrate %	..	20.9
Calcium %	..	0.24

Essential amino acids (g/16 g N):

Lysine	..	6.4
Methionine	..	1.2
Cystine	..	1.7
Total S-A.A.	..	2.9
Tryptophan	..	1.4
Threonine	..	4.0
P.E.R.	..	2.2 @ 10% level

Use:- Whole soyabean is processed mainly for its oil. Fermented products (Miso, Tofu) and milk substitutes based on soyabean are very popular in the whole of South East Asia. The low-fat soyabean which is a by-product of the oil industry contains 40-45% protein of fairly good quality.

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REDGRAM (Cajanus cajan)

Chemical composition:

Protein %	..	22.3
Fat %	..	1.7
Carbohydrate %	..	57.2
Calcium %	..	0.14

Essential amino acids (g/16 g N):

Lysine	..	7.2
Methionine	..	1.2
Cystine	..	1.4
Total S-A.A.	..	2.6
Tryptophan	..	0.5
Threonine	..	3.8
P.E.R.	..	1.3 @ 12% level

Use:- A legume mainly consumed as cooked dhal or as soup. Green pods are used as vegetable.

BLACKGRAM (Phaseolus munic)

Chemical composition:

Protein %	..	24.0
Fat %	..	1.4
Carbohydrate %	..	60.3
Calcium %	..	0.20

Essential amino acids (g/16 g N):

Lysine	..	6.4
Methionine	..	1.4
Cystine	..	1.2
Total S-A.A.	..	2.6

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Tryptophan	..	1.1
Threonine	..	3.5
P.E.R.	..	1.2 @ 12% level

Use:- A legumeused in the Indian cookery mainly for making fermented product known as idli. It is also consumed as cooked dhal.

HORSE GRAM (Dolichos biflorus)

Chemical composition:

Protein %	..	22.0
Fat %	..	0.5
Carbohydrate %	..	57.3
Calcium %	..	0.28

Essential amino acids (g/16 g N):

Lysine	..	8.0
Methionine	..	1.3
Cystine	..	2.3
Total S-A.A.	..	3.6
Tryptophan	..	1.1
Threonine	..	3.7
P.E.R.	..	0.7 @ 12% level

Use:- A legume mainly consumed both in boiled and fried forms.

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KHESARI (Lathyrus sativus)

Chemical composition (g%):

Protein	..	28.2
Fat	..	0.6
Carbohydrate	..	58.2
Calcium	..	0.11

Essential amino acids (g/16 g N):

Lysine	..	7.3
Methionine	..	0.7
Cystine	..	0.7
Total S-A.A.	..	1.4
Tryptophan	..	0.8
Threonine	..	2.6

Use:- This legume is banned for human consumption in view of its toxicity, which causes Lathyrism. However, it is widely used in certain areas of the country. Toxic elements in the pulse are water soluble and can be largely removed by treatment of the seed in boiling water.

BENGALGRAM (Cicer arietiunum)

Chemical composition:

Protein	..	17.1
Fat %	..	5.3
Carbohydrate %	..	61.2
Calcium	..	0.19
Minerals	..	2.7

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Amino acid composition (g/16 g N):

Lysine	..	6.88
Methionine	..	1.28
Cystine	..	1.44
Total S-A.A.	..	2.72
Tryptophan	..	0.8
Threonine	..	3.412
P.E.R.	..	1.8 @ 10% level

Uses:- It is consumed as boiled, fried or parched. Ground into flour, it is one of the chief ingredients together with ghee and sugar in many forms of Indian confectionery.

GREEN GRAM (Phaseolus aureus)

Chemical composition (g %):

Protein	..	24.0
Fat	..	1.3
Carbohydrate	..	56.7
Calcium	..	0.14

Essential amino acids (g/16 g N):

Lysine	..	6.8
Methionine	..	1.1
Cystine	..	0.6
Total S-A.A.	..	1.7
Tryptophan	..	0.7
Threonine	..	3.2
P.E.R.	..	1.2 @ 12% level

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Use:- A legume used in a variety of preparations. The split gram is boiled, fried or ground into paste as may be required for different dishes. The split dehusked bean is used for soup.

COTTONSEED (Gossypium arboreum)

Chemical composition (%):

Protein	..	12.42
Carbohydrate	..	14
Minerals	..	2.17

Essential amino acid composition (g/16 g N):

Lysine	..	4.2
Methionine	..	1.5
Cystine	..	-
Threonine	..	3.5
Tryptophan	..	1.6

Use:- The oil of this oilseed is used for cooking purpose. The oil content is 14 to 19% in seed. Vegetable ghee is manufactured from the oil.

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CHAPTER 5

INFRASTRUCTURAL FACILITIES AVAILABLE AND NEEDED

5.1 Finance: The total financial outlay for the Fifth Five Year Plan (1974-79) of the State is Rs. 2,621 crores. Out of this the State's own resources have been estimated at Rs. 1,417.54 crores, and the balance of about Rs.1,204 crores is expected to be met by Central assistance and partly by higher open market borrowing. Total allocation for nutrition programme in the Plan is Rs. 38.05 crores and its allocation under different heads is (i) Rs. 17.5 crores for nutrition programme in Tribal areas, (ii) Rs. 10.50 crores for midday meals programme and (iii) Rs. 10.05 crores for feeding programme in slum areas. An outlay of Rs.91.75 crores has been provided for large and medium industries including Rs. 22.0 crores for the co-operative sector. It is proposed to promote development of industries in under-developed and backward areas of the State, and concessional finance is made available through the financial institutions, Bhandara, Yeotmal, and Chandrapur.districts of Vidarbha are declared as industrially backward and eligible for receiving concessions offered by financial institutions

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for development of industries. Regional development Corporations are also set up to provide necessary infrastructure facilities, financial assistance, technical guidance and marketing assistance to the industrial units coming up in under-developed areas. An outlay of Rs.1,350 lakhs is proposed for development of industrial areas through MIDC, Rs. 200 lakhs in terms of loans for creation of fixed assets to small and medium industries through MSFC; Rs. 500 lakhs as capital contribution to SICOM for financial incentives and other services Rs. 1,065 lakhs to four Regional Development Cooperations.

The MSFC extends financial assistance for acquiring fixed assets in the form of land, factory building, plant and machinery. It is empowered to sanction loans and/or other financial assistance to the extent of Rs. 30 lakhs to limited companies or Registered Co-operative Societies and Rs. 15 lakhs to proprietory and partnership concerns. It can also grant assistance to industrial concerns whose net effective capital does not exceed Rs. One crore. The loan has to be repaid in a period normally not exceeding 10 days. The present rate of interest is Rs. 14.5% with rebate of 2% per annum

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The MSFC has the following schemes:

1) World Bank loan through Industrial Development Bank of India

Under this scheme MSFC renders financial assistance for import of plant and machinery from any member country of the World Bank, including Switzerland. The financial assistance under World Bank loan is available for projects whose capital cost exceeds Rs. 100 crores.

2) Assistance in soft loan areas:

Chandrapur, Bhandara, Buldhana and Yeotmal gave been declared as backward districts in Vidarbha and small and medium scale industries in these districts are given loans at concessional rate of interest at 8½%.

MIDC promote and assists in the rapid and orderly growth and development of industries in the region. It creates base for industrial growth by developing industrial areas. The Government land and other lands acquired by the Govt. are entrusted to the Corporation for development as industrial areas. The Corporation prepares a broad layout of each area and undertakes development of land, construction of internal roads, provision of water supply and storm water drains. The MSEB supplies electric power on its own terms and conditions in these industrial areas. The district-wise break-up of the ten industrial areas developed by the Corporation in Vidarbha is as follows:

Nagpur District - Nagpur and Kanhan, Akola District - Akola, Chandrapur District - Ghugus and Chanrapur,

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Yeotmal District - Yeotmal, Wardha District - Wardha, Bhandara District - Gondia, Buldhana District - Khamgaon and Amroati District - Amroati. Other infrastructural facilities like chemicals, equipment and machinery can be availed as there are a number of machinery fabrication units as well as chemical suppliers in cities and district places of the region. It may be necessary to entail infrastructural facilities like industrial areas, etc. to the remainder of towns (50).

In addition to these Kalmeshwar and Kamptee in Nagpur district are included in the further programme for development of industrial areas. The information on MIDC industrial areas in Vidarbha as on 31-3-77 is given in two groups, namely:

1) Developing districts - Nagpur, Akola, Amraoti and Wardha

2) Backward districts - Buldhana, Bhandara, Yeotmal and Chandrapur (Table 5-1)

Achievements of Maharashtra Industries Development Corporation are listed below.

Infrastructural facilities are thus available for setting up new units in district places.

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ACHIEVEMENT OF MIDC AT A GLANCE

1. No. of industrial areas	54
2. Land acquired	15002.87 hectares
3. Area of industrial plots allotted	4854.23 hectares
4. a) i) Sheds constructed	656
ii) Sheds under construction	310
b) Galas in flatted type building	229
5. Water supply capacity created	6,73,000 M3/day
6. Length of roads constructed (till March 76)	541.70 Kms
7. Units in production	2599
8. Investment generated	Rs.61157.35 lakhs
9. Employment generated	122134
10. Value of goods produced	Rs.105154.29 lakhs
11. Expenditure on industrial areas	
i) Developed parts	Rs.911.96 lakhs
ii) Developing parts	Rs. 1292.15 lakhs
12. Expenditure on sheds and Galas in flatted type buildings	Rs. 476.15 lakhs
13. Expenditure on water supply scheme	Rs. 2644.50 lakhs
14. Revenue receipts	
i) Receipts by sale of water	Rs. 446.74 lakhs
ii) Receipts through disposal of plots, sheds and galas	Rs. 229.41 lakhs

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THE STATE INDUSTRIAL & INVESTMENT CORPORATION OF MAHARASHTRA LTD.

SICOM offers assistance that an industry requires, not finance alone, but a package of services. SICO has, therefore, adopted as a major innovation, a marketing approach to the problem of industrial promotion.

Small Scale Industries coming up in the developing regions need special care. Realising this, SICOM offers the following special service to this sector:

(a) Project identification: SICOM engineers identify new project possibilities.

(b) Investment guidance : Entrepreneurs are identified even at the district level; advice is given on right type and size of industry suitable to individual entreprenour.

(c) Locational guidance: Small business section evaluates various factors and suggests the most appropriate and profitable location for an industrial unit.

(d) Financial assistance: SICOM has flexible financial schemes tailored to suit individual needs. Recommended for small scale unit is:

Capital participation scheme: Under this special scheme for small scale industry, in participation with 13 commercial banks and the MSFC, SICOM extends financial assistance to the extent of 25% of the fixed assets on easy repayment terms. The participating institutions are expected to give 50% against fixed assets as a term loan. In respect of technicians SICOM's assistance can come up to 30%.

Four years moratorium for repayment of loan and 2 years moratorium for interest. Accrued interest is collected in 3rd and 4th year in equal instalments alon with interest of respective years.

The important financial benefits of the capital participation scheme are:

* Increased profitability
* Differed payment of interest
* Easy repayment of loan
* Reasonable rates of interest

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(e) Technical consultancy service: SICOM offers Consultancy Services in all matters through its own experts. Wherever needed, special consultants are commissioned.

(f) Package scheme of incentives: SICOM extends all assistance in availing of various incentives from the concerned authorities.

(g) Co-ordinations: For the success of an enterprise, particularly in backward area, assistance from many agencies is required. SICOM tries to co-ordinate the efforts of the various organisations for maximising assistance to entrepreneurs.

Assistance is offered in securing land, power, water, etc. and in helping to improve the infractructure.

(h) Central subsidy scheme: Under the Government of India's Central Subsidy Scheme, financial assistance by way of outright grant subsidy is given to new industrial units set up in specified backward districts. In Vidarbha the Central subsidy is applied to Chandrapur district.

(i) Preparation of special reports: SICOM has undertaken preparation of survey reports of various districts in the State to assess the potential for industries.

(j) Development of local entreprenourship: With a view to motivate the local people in whole heartedly participating in the industrial development of the region, SICOM participates in group discussions, seminars, etc. and organise training programmes at various places in co-operation with the other institutions of the Inter-Institutional Group for Maharashtra.

MAHARASHTRA GOVERNMENT'S NEW PACKAGE SCHEME OF INCENTIVES

The Maharashtra Government's Package Scheme of Graded Incentives was in operation from August 15, 1973. With the view to making the scheme administratively easier to operate and even more attractive for industry, especially employment-oriented industry, Maharashtra Government revised the said scheme and a new scheme came into operation from August 1, 1976.

SICOM is an agent for operating the scheme for medium and large scale projects. The highlights of the new scheme are as follows:

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The last date for receipt of application under the scheme is 31st July 1979. Under the New Graded Scheme, the State of Maharashtra has been divided into 3 groups. The various areas covered in Group-A, Group-B and Group-C are listed in Table 5.2.

Areas falling under Group-A are developed areas and are not entitled to any incentives. The areas in Group-B and Group-C are developing areas. The scales of incentives increase from Group-B to Group-C in graded manner, the incentives being maximum in areas falling under Group-C.

NATURE OF INCENTIVES

1. Special capital incentive
2. Interest-free loans either to "recoup" sales tax paid or to invest in fixed asset.
3. Relief in electricity tariff, octroi duty, water royalities and non-agricultural assessment.
4. Contribution towards the cost of feasibility study
5. Preferential treatment in Government Purchase programme
6. Assistance in technical training of personnel.

1. SPECIAL CAPITAL INCENTIVE

For the first time a Special Capital Incentive is introduced in the nature of an interest-free loan to the extent of 15% of the fixed assets, subject to maximum of Rs. 15 lakhs. This Special Capital Incentives is available in selected growth centres. This loan is repayable after 12 years in 6 equal annual instalments.

2. SALES TAX LOAN

The quantum and nature of sales tax loan depend on whether it is sought by:

(a) New industrial unit to be started in the developing areas of Maharashtra;

(b) An existing unit in the developed areas of Maharashtra

(c) An existing unit in the developing areas of Maharashtra

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The details of the sales-tax loan are as follows:

(a) A new industrial unit to be started in the developing areas of Maharashtra (sales tax loan Part I):

The amount equivalent to the sales tax liability of the eligible unit in the initial years of production is refunded in the form of interest-free and unsecured loan which is repayable after 12 years in 6 equal annual instalments. For new unit, sales tax loan to the extent of 4 percent of the fixed assets plus employment-oriented loan as described below would be available* for each of the first 5 years if the new unit is located in Group-B and 6 years if the new unit is located in Group-B and 8 years if the new unit is located in Group-C. The employment oriented loan under Part I of the scheme will be available at the rate of Rs. 1200/- per job created per year limited to 4 percent of the fixed assets of the new unit. The overall ceiling of the sales tax loan under Part I will be limited to 8 percent of the fixed assets or sales tax paid whichever is lower with a maximum of Rs. 50 lakhs during the entire period of eligibility. In other words, half of the ceiling is determined by the number of jobs created.

*For medium and large scale units, this loan would be available for each of them

(b) An existing unit in the developed areas of Maharashtra (Sales tax loan under Part II).

A unit in developed area of Maharashtra which wants to set up a unit in developing areas of Maharashtra will be eligible for sales tax loan Part II if its sales tax liability for previous 3 consecutive years immediately prior to the year in which the application is made is more than Rs. 9 lakhs (i.e. average of 3 lakhs or more per year). The amount of loan would be 20 percent of the fixed assets or 3 years sales tax paid in the block of years selected by the party whichever is less subject to a maximum of Rs. 40 lakhs for Group-B and 25 percent of the fixed assets or 4 years sales tax paid in the block of years, selected by the party whichever is less subject to a maximum of Rs. 50 lakhs in Group-C.

(c) An existing unit in developing areas of Maharashtra

The benefits mentioned in (b) above are available under the Graded Scheme of Incentives to an existing unit in developing areas if its average sales tax liability of 3 consecutive years immediately prior to the year in which the application is made is Rs.1 lakh or more per year (as against Rs.3 lakhs in (b) above).

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3. RELIEF FROM DUTIES AND RATS

1) Electricity Tariff

All eligible units having maximum demand of 200 KW or more in any month will receive for all such months a rebate on electricity tariff so as to bring the tariff on par with Tata's Tariff in Bombay. The eligible units will thus have to pay to Maharashtra State Electricity Board (or any other agency supplying power) only the Tata Tariff. The amount of rebate will be claimed by the agency concerned from SICOM. The period for which this incentive will be available is indicated in Appendix-B.

2) Octroi Duty

Octroi duty paid on capital equipment, building materials and raw materials imported by eligible units w within the limits of local authorities will be refunded. This refund will be limited to 1.6 percent of the value of only the capital equipment and building materials so imported. The period for which this incentive is available is indicated in Appendix-B.

3) Water Royalties:

Eligible unit which lift water from public water sources and are required to pay water royalties thereon will be exempted from payment of such royalty. The period for which they will be so exempted in in various groups is shown in Appendix-B.

4) Non-agricultural assessment:

The eligible units will be exempted from payment of non-agricultural assessment on the land acquired for the purpose of the industrial units. The period for which they will be so exempted in various groups is shown in Appendix-B.

4. CONTRIBUTION TOWARDS COST OF FEASIBILITY STUDY

SICOM will give 75 percent contribution towards the cost of preparation of a feasibility study either undertaken by SICOM or done through an agency approved by it. After the project is implemented the contribution

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shall be treated as unsecured loan for a period of 5 years from the date of disbursement. The loan will carry an appropriate rate of interest. If the project is not implemented within the prescribed time, the feasibility study shall become SICOM's property. The extent of contribution towards the cost of feasibility study is the same for all the areas.

5. PREFERENTIAL TREATMENT IN GOVERNMENT PURCHASE PROGRAMME

The State Government makes purchases through the Central Stores Purchasing Organisation at the lower prices in open competitive tender. 33 percent of these purchases will be made fromthe eligible units. The period for which this incentive is available in various groups is shown in Appendix-B.

6. ASSISTANCE IN TECHNICAL TRAINING OF PERSONNEL

For providing services of skilled personnel, Government will assist the eligible units by working if necessary an additional shift in local technical High Schools; the eligible unit shall not be required to pay for the use of equipment or the establishment expenses. This incentive is applicable to all the areas falling under Group-B and C and will be available for the first 3 years.

Table 5.2

Classification of areas into groups

District	Developed areas Group-A	Group-B	Group-C
I. Nagpur division			
1. Buldhana			Whole district
2. Bhandara			-do-
3. Ghandrapur			-do-
4. Yeotmal			-do-
5. Amravati			-do-
6. Wardha			-do-
7. Akola			-do-
8. Nagpur		Nagpur taluka.	Remaining dists.

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Appendix B

Incentive	Extent of incentive available in areas under	
	Group B	Group C
1	2	3
1. Electricity tariff	For small scale industries	
	For 5 years from the date of commencement of production	For 7 years from the date of commencement of production.
	For medium and large scale industries	
	For 4 years from the date of commencement of production.	For 5 years from the date of commencement of production.
2. Octroi duty	For small scale industries	
	For 6 years from the date of commencement of production.	For 8 years from the date of commencement of production.
	For medium and large scale industries	
	For 5 years from the date of commencement of production.	For 6 years from the date of commencement of production.
3. Water royalties	For small scale industries	
	For 6 years from the date of commencement of production.	For 8 years from the date of commencement of production.
	For medium and large scale industries	
	For 5 years from the date of commencement of production.	For 6 years from the date of commencement of production.
4. Non-agricultural assessment	For small scale industries	
	For 6 years from the date of commencement of production.	For 8 years from the date of commencement of production.
	For medium and large scale industries	
	For 5 years from the date of commencement of production.	For 6 years from the date of commencement of production.

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Incentive	Extent of incentive available in areas under	
	Group B	Group C
5. Contribution towards cost of feasibility study.	Same in all groups	
6. Preferential treatment in Government purchase programme	Small scale industries	
	For 6 years from the date of commencement of production.	For 8 years from the date of commencement of production.
	For medium and large scale industries	
	For 5 years from the date of commencement of production.	For 6 years from the date of commencement of production.
7. Assistance in Technical training of personnel.	Same as in all groups	

THE CENTRAL SUBSIDY SCHEME

Under the Central Subsidy Scheme, announced in August 1971, the Govt. of India, offers financial assistance by way of outright grant or subsidy for new industrial units to be set up in specified backward districts and for existing industrial units undertaking substantial expansion/modernisation, etc. in those districts.

The various details of the scheme, as prevalent on September 1, 1973 are given in the succedding paragraphs.

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ELIGIBILITY

The Central Subsidy Scheme is applicable to industrial units whose total fixed capital investment does not exceed Rs. 1 crore. Cases entailing a total fixed capital investment exceeding Rs. 1 crore will be considered on a selective basis by a State-level Committee.

DISTRICTS ELIGIBLE IN VIDARBHA

In Vidarbha, the Central Subsidy is applicable to Chandrapur district .

CRITERIA FOR ELIGIBILITY: In Chandrapur.

The Central Subsidy is applicable to:

(a) new industrial units for the setting up of which "effective steps" have been taken on or after August 26, 1971.

(b) existing industrial units undertaking "substantial expansion" for which "effective steps" have been taken on or after August 26, 1971.

EXTENT OF SUBSIDY ADMISSIBLE

15 percent of fixed capital investment

The Central subsidy to the extent of 15 percent of the total fixed capital investment is admissible to eligible industrial units which have gone into production on or after March 1973 or expect to go into production after that date. The quantum pf Central Subsidy in such cases is subject to a ceiling of Rs. 15 lakhs.

10 percent of the fixed capital investment

The Central Subsidy to the extent of 10 percent of the total fixed capital investment is admissible to eligible industrial units which have gone into production before March 1, 1973. The qutnaum of Central subsidy in such cases is subject to a ceiling of Rs. 5 lalhs.

The above two rates and ceiling of Central subsidy also apply to units undertaking "substantial expansion" the date of production clause being applicable to their production on account of expansion.

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DEVELOPMENT CORPORATION OF VIDARBHA LTD

The Development Corporation of Vidarbha Ltd., was established by Govt. of Maharashtra on 3rd December 1970. It started working on 21st May 1971.

The objectives of this Corporation was spelt out by the Board of Directors and are as follows:

1) To promote, encourage and assist orderly establishment, growth and development of industries and industrialisation in this region;

2) To act as a catalytic agent for promotion of industrialization;

3) To help new entrepreneurs in different ways to start their own industries;

4) To implement our own projects and schemes, based on the local resources and employment potential, which would in turn generate new industries in this region;

5) To prepare and propose several schemes and make them available to the prospective entrepreneurs. The schemes would be such as could be based on resources locally available.

CONSULTANCY WING

Lack of efficient consultancy service was a major problem faced by the entrepreneurs especially in the small scale industries from this area. In order to bridge this gap DCVL has started its own consultancy wing, which is rendering valuable assistance to the prospective industalaists of the area. A large number of entrepreneurs have taken advantage of the services provided by this wing.

The wing renders valuable assistance to the new entrepreneurs in product identification, preparation of project reports, location of industry, sources of machinery and raw material supply and also in undertaking market surveys.

It also helps them in establishing liaison with Government agencies and institutions like Directorate of Industries, SICOM, MSFC, MSSIDC, MIDC, NRDC, NCL, etc. for getting technical and other assistance and solving their difficulties. It also disseminates to the industrialists, information and directives as issued by Government from time to time.

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Parties who have been favoured with industrial licence, letters of intent/DGTD Registration by Govt. of India to set up industries in the region are assisted by this wing, to overcome their difficulties by taking up their individual problems with concerned authorities and departments for speedy implementation of their projects.

To identify the proper entrepreneurs and develop entrepreneurial abilities, the Development Corporation of Vidarbha Ltd., along with other voluntary organisations have been conducting courses of Entrepreneural Development and inculcate educated youths with the ideas of self enterprise as a best method of employment. This experiment has proved quite successful and many young persons have taken advantage of it.

SCHEME FOR ASSISTANCE TO EDUCATED UNEMPLOYED

The programme for selfemployment is one of the major sources to solve the problem of unemployment in the country specially for the educated persons. The Planning Commission approved the scheme of "Half-a-Million Jobs Programme" under which the educated unemployed were to be provided with jobs. The broad details of the scheme taken by the State Govt. under this programme consist of training programmes, subsidies and stipends to the educated unemployed especially Engineers and other technically qualified persons, establishment of functional and ancillary industrial estates, mini-industrial estates, shopping centres, etc. The programme has been in action since the last four years. The State Government is operating it through various Regional Development Corporations. In Vidarbha, the Development Corporation of Vidarbha Ltd., is the agency for operating these programmes.

Self employment assistance for seed capital

Under this scheme, persons between 18 and 40 years of age and who have passed SSC or ITI are edlgible. The persons who are unemployed can only take the benefit of this scheme. Under the scheme of assistance to educated unemployed for seed money, entrepreneurs will be given 10% of the total cost of the project as seed money. Out of the rest of the amount, the applicant has to raise 15% of his total requirement while the remaining 75% is considered for sanction by the Financing Institutions.

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Apart from the above scheme of seed money assistance training programmes are being organised and implemented by the Directorate of Employment. There are two schemes that are being operated.

1. Training for acquisition and upgradation of skilled for employment in private sector establishments and public sector undertakings;

2. Scheme for training of SC/ST etc. for Government jobs where reserved quotas are un-filled.

During the training programme the candidates are being given stipends according to their educational discipline. The Development Corporation of Vidarbha is entrusted with the work of disbursement of stipends to the candidates who are placed by the Employment Exchange.

Mini industrial estates and sheds

In 1976-77, we are taking up construction of mini industrial estates and sheds. Primarily, atleast one such estate with ten to fifteen sheds will be constructed in every district. This will help in solving the problem of sites that is faced by many young entrepreneurs, and will involve an expenditure of Rs. 2 lakhs per estate. The total cost of the project would be approximately Rs. 16 lakhs. Majority of the units to be housed in these estates and sheds will be of local entrepreneurs preferably from educated unemployed.

Sites have been identified in all districts except Yeotmal and government has been approached for making them available to us.

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CHAPTER 6

TECHNOLOGIES AVAILABLE/NEEDED

6.1 CEREALS

Jowar - Pearling of jowar: Pearling of jowar means the reduction in its fibre content by removal of the outer coarse bran coat. Jowar is consumed in the region as a whole meal flour. The removal of the coarse outer coat also increases the palatability and gives an attractive appearance without much loss in its nutritional value. The acceptability of Bhakri from pearled jowar than those made from whole meal flour is more. Jowar is not liked by people who are accustomed to cereals like rice and wheat; mainly due to the coarseness of the grain.

The process consists of softening of the outer bran by addition of 3 to 5% water, mixing in a mixer for obtaining uniform moisture distribution in the grain, and conditioning the mix for 5 to 15 minutes before milling. The pearling is carried out in cone-polishers used by the rice mills. The polisher gives 7 to 8% degree of polishing. The various fractions separated are: (1) pearled jowar, (2) brokens of different grade, (3) bran and (4) husk or glumes. Depending on the degree of polishing, the yield of polished jowar is 75 to 80%.

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.illing of the polished jowar in a roller flour mill gives soji (33.5%), maida (33.7%) atta (26.5%) and bran (4.1%).

Uses: Pearled jowar flour can be used for preparation of Bhakri, dosa, and can also be added to the extent of 20% for making chapatiss. Samolina (soji) prepared from pearled jowar can be utilized for the preparation of sweet and savoury dishes.

Advantages: The idle capacity of rice mills can be utilised for pearling of jowar.

RICE

Better methods of harvesting and drying of paddy: It has been established that milling quality can be improved if paddy is harvested three to five days ahead of customary stages of harvest, when the average moisture content is 22 to 24 percent. The harvest paddy should be threshed immediately and dried in two stages to about 14% moisture either in the sun or a mechanical dryer. A general recommended procedure is to dry the paddy in the sun up to 17% moisture with stirring at half hour intervals followed by a two to three hour tempering under cover and final drying to about 14% moisture for improved milling quality.

Paddy crack detector: A simple inexpensive gadget has been developed for detecting cracks in intact paddy without de-husking the grains manually. This gadget also enables the detection of chalkiness, red colour and also insect infestation.

CURING OF RICE (Steamed rice)

Ageing of rice after harvest: It is well-known that rice obtained from paddy shortly after harvest has a very poor cooking quality. It cooks to a pasty mass, swells less during cooking, and yields a thick sticky 'gruel'. The grain also bursts lengthwise shortly during cooking, and expands relatively less along the length compared to old rice, thus appearing short and flat; while old rice grains appear round and long after cooking. These drawbacks of new rice progressively decrease on storage and finally disappear after 6-10 months.

Changes during ageing: Basic work has indicated that cell walls in new rice are relatively more fragile and disintegrate easily during cooking. The consequent greater dispersal of the cell contents in the cooking water is mainly responsible for the pastiness. Changes in the physical and chemical properties of the starch (such as its solubility, viscosity and iodine-binding capacity) during ageing of the rice have also been observed, which also partially contribute to the decreasing pastiness. In addition, the progressive decrease in the content of the enzyme amylase in rice during storage has also been postulated to influcnce the cooking behaviour. The pastiness in new rice results in greater cohesiveness of the grains and hence to lesser swelling and higher bulk density of the cooked product.

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(c) Curing of paddy: It was found that if new paddy is steamed and then kept hot for some time (½ to 2 hrs) the rice milled from such paddy cooks just like old stored rice. The cooked grains are fluffy, the pastiness disappears, and the loss of solids into the gruel decreases. Based on this, a method for large-scale curing of new paddy has been devised.

The method can be carried out in the existing rice mills wherever facilities for steaming or for parboiling are available. The raw paddy is charged into the over-head steaming tanks and steam is passed for about 15 minutes, leaving the bottom valve open for draining out the condensed water. After steaming, the paddy must be kept hot for half to two hours depending on its age to complete the curing process. Completely fresh paddy will need to be kept hot for about 2 hours, lesser time being necessary as it becomes progressively older. The paddy can be kept hot for the necessary time either by leaving it in the tank itself after steaming or taking out and collecting in a heap and covering the heap with a suitable cover. The paddy absorbs about 5% moisture during the steaming and has to be dried carefully subsequently. This is best achieved by drying in the shade or by drying in a thick layer with repeated turning over in the sun.

The usefulness and practicability of this method was demonstrated to millers. Since then, it has been found very satisfactory by rice millers and is widely used in many

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States of India where raw rice is the staple cereal. This process has the additional advantage that the steaming enables a substantially higher amount of thiamine to be retained in the milled rice than normally, thus giving a more nutritious product. The steaming also inactivates the fat-splitting enzyme of rice, lipase; the rice obtained on milling acquires better storage quality thereby, and the bran remains stable, capable of yielding FFA free edible quality oil.

In initial trials, this method was found to have the disadvantage of giving slightly higher breakage of the rice during milling. However, it has been recently found that if field paddy harvested at a high moisture content is directly treated in this method without much preliminary drying, no additional breakage occurs. The paddy can be finally dried after the curing treatment.

(b) Curing of new rice after milling: In view of the higher milling breakage of steamed paddy encountered in the initial experiments, curing of new rice was attempted after milling.

A humid heat treatment of rice was found to be effective for its accelerated ageing. The method consists, firstly, of heating the rice in a closed container and, secondly, of storing the pre-heated rice in a closed hot chamber for varying letnths of time. The time of storage is dependent on the temperature of the treatment - higher the temperature, lower is the time required for hot storage. Thus on treatment

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at a temperature of 95°C, about 2 hours of storage is sufficient to cure the rice; while at 50°C, about 10 days are required. Pre-heating to about 80°C followed by storage at 70-75°C appears to be most convenient for practical application; the total processing time required under this condition is about 3 days.

Laboratory trials with this method have been fully satisfactory and have given cured rice with excellent cooking quality. Initial experiments for application of this method in large commercial batches have also been completed.

(c) Curing of new rice at home: (i) A method of cooking new rice without pastiness has also been devised. The principle of the method is to give a semi-parboiling treatment to the rice (partial soaking and steaming) just before it is cooked, which makes it cook without the usual pastiness. The method involves soaking of the rice for about one hour in water (or half-an-hour in warm water) followed by steaming for 15 minutes, after which it is immediately cooked. Since the rice is already partially cooked and hot after the soaking and steaming, the final cooking takes only a little time; thus the total time needed (excluding that needed for soaking) is almost the same as needed in usual cooking.

A simple rice cooker has been devised where the entire procedure can be carried out with ease. The rice is taken on the perforated tray which is first lowered into the warm water contained in the vessel. After soaking, the tray is raised

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and held above the level of the water by means of the pin and the rice is steamed by heating the water to boil. Finally, the tray is again lowered into the hot water to complete the cooking process.

ii) A home-scale curing treatment can also be given to the rice. The new rice is taken in a vessel with a closely fitting lid and heated with continuous shaking over a low fire till steam starts coming out; the vessel is now kept hot by covering with heavy cloth or a jute bag. The entire process is repeated once or twice more at intervals of half an hour each. After final slow cooling, the rice will be found to have become quite well cured.

Other applications of rice curing: Preliminary experiments have shown that these methods of curing can materially improve the cooking quality of certain varieties of rice with inherently poor cooking behaviour. This is of great economic significance, because there are certain varieties of paddy which are extremely high yielding but have very poor cooking quality. These varieties are therefore rarely grown at present inspite of their high yielding potential. But if the cooking quality of these varieties can be improved by the curing treatment, it will enable the utilization, and hence wider cultivation of these high yielding varieties, thus increasing greatly the availability of food in the country.

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Paddy destoner: To improve the yield and quality of rice it is essential to clean and grade paddy, based on shape, size, specific gravity and surface characteristics before milling on a vibrating screen. An efficient destoner comprises of an inclined plane and works on the principle of specific gravity and difference in surface roughness. Such a destoner has been designed at the Institute. The destoner in combination with a chaff cleaner not only improves the milling efficiency but also prolongs the life of the shellers.

Mini rice mill: A major portion of the paddy produced in the region is processed through huller type mills. The yield of rice in these mills is about 5% less than the modern rice mills and the husk gets powdered along with the bran which makes the extraction of bran oil un-economical. The huller type mills are low capacity (300-500 kgs paddy/hr.) mills where the shelling and polishing operations are carried out simultaneously, resulting in highly polished white rice.

CFTRI, Mysore has developed a "Mini-rice mill" which gives yields comparable to that obtained in commercial type rice mills of improved designs. It consists of paddy cleaner, shellr, separator, and a polisher. Centrifugal type sheller is fitted in these mills as it is more suited for milling mixed paddy varieties and fresh paddy with higher moisture content. The separator is small and compact and the polisher could be of any desired type (vertical cone polisher or horizontal rotor polisher) including the huller which is used for milling

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paddy. However, the huller, while polishing, introduces slightly more breakage than other type of polishers.

The operating capacity of the Mini rice mills is 500 kgs of paddy/hour costing Rs. 30,000. The power requirement is 10 KW and the yield of head rice is 68%. The design details of the proto-type unit (blue print) are available to intended fabricators at a nominal cost of Rs. 500/- only. The existing huller type mills can be replaced by these "Mini rice mills" in a phased manner; demonstration unit one each in Chandrapur and Bhandara Districts should be set up by Development Corporation of Vidarbha Ltd., to act as nucleus for promption of "Mini-rice mills" in the region.

Modernisation of rice mills: The organised rice mills in the region are of two types, namely (1) Sheller-cum-cone-polisher and (2) Sheller-cum-huller types. The disc shellers should be replaced by rubber roller shellers of the same capacity and hullers used for polishing with cone polishers. The modernization of rice mills therefore involves - (1) Two stage drying (sun or mechanical) of paddy (2) Paddy cleaner and destoner, (3) rubber roller sheller, and (4) Bran stabilization unit.

Rice bran oil (edible): Vidarbha produces 24,800 tonnes of rice bran from which about 3,968 tonnes of edible oil can be recovered. For obtaining edible oil, the rice bran should be extracted immediately after polishing operation as its FFA

content increases to 12 to 15% within 24 hours. If the FFA in rice bran oil increases beyond 15% it can not be economically converted into edible oil because of the higher refining losses. Therefore to produce low FFA oil, the bran has to be solvent extracted within 24 hrs or it has to be suitably heat treated to inactivate the lipase enzyme.

Since it is difficult to collect and use rice bran within 24 hours after polishing, for solvent extraction, it has to be established to extend the storage period. Bran stabilisation could be adopted by the milling industry without involving complicated machinery and equipment.

The following methods have been found to be efficient in stabilizing the rice bran:

I. Batch type stabilization of rice bran using electrical heat

The equipment consists of a jacketed revolving drum with an air tight lid provided with vent valve and dial thermometer. Tilting arrangements are provided to unload the treated material. About 50 kgs of bran could be treated at a time and period of treatment is about 30 minutes. This equipment could treat all the bran obtaining in a plant processing 2 tonnes paddy per hour.

The approximate cost of the equipment is Rs. 10,000/- and the cost of treatment is estimated to be about Rs. 35/- to Rs. 40/- per tonne of bran.

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II. Batch type stabilization of rice bran using steam

Studies have shown that the steaming tanks used in the parboiling process of paddy could be used for bran stabilization. Rice bran has to be steamed in these tanks for 20 to 30 minutes and such steamed bran dried in shade overnight. It may also be sun dried for 3 to 4 hours. Bran treated by this method has been found to keep upto 25 days without appreciable rise in FFA. The cost of treatment is estimated to be only Rs. 10/- to 25/- per tonne of bran.

III. Continuous stabilization using steam in simple equipments

The followingequipmentswere used for large scale trials and have given satisfactory performance.

1. Tempering unit: This unit consists of a jacketed cylindrical drum 4' dia. and 10' long. Paddle type conveyors are provided which also mix the material. Both jacketed and open heating of the material by steam are provided. The capacity is around 1 tonne of bran per hour and the cost of treatment is Rs. 15/- to Rs.20/- per tonne of bran. This equipment at present is being used for pre-conditioning of oil bearing materials before oil extraction.

2. Pre-conditionin, units of oil expellers: These units are also used for reconditioning of oil bearing materials before oil is extracted in expellers and are usually attached to the oil expellers. These units consist of jacketed semi-cylinderical

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drums with paddle type conveyors. Both jacketed and open heating of material by steam are provided. Two units with capacity one tonne and 250 kgs of bran per hour have been used. Bran treated in all these units kept upto 25 days without appreciable rise in FFA.

It is significant to note that the cost of bran stabilization using steam was low and the investment for such equipments not so high. In case of steaming tanks and pre-conditioners of oil expellers the cost is less than Rs. 5000/- per unit while the tempering unit is estimated to cost approximately Rs. 10,000/-

Storage of stabilized rice bran: It has been observed that insect infestation in stabilized rice bran causes significant rise in FFA level. Therefore if the bran has to be stored for longer period i.e. for 1 to 2 months then precaution has to be taken to prevent the same from insect infestation. Insect proofing of gunny bags before filling with stabilized bran and suitable fumigation treatment during storage to prevent cross infestation have been suggested.

Bran from parboiled paddy: It has been observed that if soaked paddy is steamed properly, the lipase is inactivated during parboiling process. If the moisture content of the bran is more than 12.5% it has been found to cause fungus growth leading to a spurt in FFA level. Therefore bran from parboiled paddy has to be dried to below 12% moisture and protected from insect infestation.

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Parboiling of paddy: Nearly 50% of the total rice produced in the country is parboiled mainly in Kerala, West Bengal, Tamil Nadu, Andhra, Karnataka, etc. and is increasing year by year. The importance of parboiling stems from the fact that the process gelatinises the starch and thus hardens the rice grain. Breakage of the grain during shelling and polishing is thereby minimised. Consequently the yield of finished head rice is increased to the extent of 5-10% in the case of hard varieties and is very much more with respect to the soft varieties. The yield of total marketable rice including brokens is also increased by about 1% by parboiling. Parboiling, therefore, adds to the total rice economy of the country. Besides this economic advantage, parboiling also results in the grain having a higher content of vitamins and minerals than the ordinary raw rice. Thus the nutritional quality of rice is enhanced. Parboiled rice also has better keeping quality as it is more resistant to insect attack than raw rice.

Although the total production of parboiled rice in India is considerable, the rice produced in commerce is generally of poor quality. The main defect in commercial samples is the bad fermented smell associated with them. They are also highly coloured and cook to a stiff consistency. In order to improve the quality of parboiled rice for making it more universally acceptable, researches were carried out at the Central Food Technological Research Institute, Mysore, resulting in the development of an improved method which can be easily adopted

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by the rice mills. The improved method and its advantages are detailed below. A short account of current methods of parboiling is first given as background information to indicate the main operations involved in the process.

Current methods: The parboiling process consists in a thorough pre-soaking of the paddy in water and subsequent cooking in a current of steam. The steamed paddy is then dried in the sun and milled. It is the common practice to soak the paddy in cold water in large cement tanks for 2-3 days, transfer to cylindrical iron kettles and steam in small batches. If the soaking time is reduced, the paddy does not get soaked sufficiently and so the grain is not fully gelatinised during steam cooking. The strength of the grain is thereby reduced and it may suffer high breakage during milling and the yield of finished rice is low. The core of the grain presents a white or opaque appearance instead of the usual translucent appearance. Hence the necessity for the prolonged (2 or 3 days) soaking; but this, in turn, causes the rice to acquire a fermented smell. The prolonged soaking is also conducive to the development of mycotoxin. Such harmful toxins have been detected in parboiled rice made by cold soaking methods.

In order to reduce the soaking time, many rice mills have been adopting what is called the "double boiling" or "Do-Bhamp" process. In this process, the paddy is raised

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to steam heat in the boiling kettles and transferred to the cement tanks containing cold water. The hot paddy rises the temperature of the soak water to 40-50°C which aids in reducing the soaking time to 24 hrs. Even in this method the fermentation cannot be eliminated because the contents of the soaking tank cool off after about 4-5 hours to the temperature range of 30-35°C which is optimum for fermentation to proceed.

Principles of the improved method: If the temperature of the soak water be increased, the absorption of water by the paddy is hastened and at 70°C, a soaking period of 3-3½ hours is sufficient. This hot soaking not only effects a reduction in soaking time but also completely eliminates the fermentation. Another modification in the improved method is that the soaking and steaming are done in the same tank, while in the customary methods, the soaking is done in cement tanks and the steaming in separate iron kettles. The improved method is, therefore, quicker and cheaper than the customary methods.

Design of new tanks for operating the improved method: Since the soaking and steaming are to be done in the same tank in the improved method, the tank (made of mild steel) should be leak-proof and should have steam coils fitted into it. The tank is erected at a height of 2-3 ft. above the ground level and fitted at the bottom with a leak-proof sliding door by opening which the parboiled paddy could be removed

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immediately after the steaming, and dried either through a mechanical dryer or even in the sun. Arrangements for slow circulation of water during soaking are also provided. An efficient steam distributor system that will make for uniform steam distribution to the contents of the tank is also introduced.

The size of the tank would depend on the steam raising capacity of the boiler with the rice mill and also on the daily production target of the mill. With rice mills, that have boilers to produce 500-1000 kg of steam/hr. it would be preferable to have a set of four tanks each of about 200-250 c.ft. capacity and made of $\frac{3}{4}$" M.S. plate and a hot water tank. With these four tanks about 20-25 tonnes of paddy could be parboiled in a 12-14 hour working day. Two batches of paddy could be parboiled in each tank. Capacity can be increased by working the tanks all the 24 hours and by increasing the number of tanks to six.

Details of the method of parboiling: Water is heated to a temperature of about 85°C by passing steam through the coils inside the parboiling tank or hot water prepared in a separate hot water tank could also be pumped into the soaking tanks. The latter will save time and increase the capacity. The paddy is then charged into the tank as quickly as possible. The paddy can be lifted mechanically through a elevator and stored in an over-head tank or bin. The resulting

temperature in the tank after dumping the paddy will be around 70-75°C. The soak water can be circulated slowly during the soaking period to effect temperature equilibrium. After letting the paddy soak for 3-3½ hours, the soak water is drained out and keeping the water discharge valve open to remove the water that condenses during the steeping, the warm paddy is raised to steam heat by letting in steam at a pressure of 50-60 lbs/sq.in. through the open steam coil. The splitting of the husk layers is indication of the completion of parboiling process. After completing the steaming the steamed paddy can be drawn off for drying by opening the bottom door. If a mechanical dryer is used, the paddy is conveyed to the dryer by a conveyor and an elevator. If sun drying is to be practiced it can be transported to the drying yards either in push carts or using human labour. Mechanical drying is preferable to sun drying since it eliminates dependence on weather and labour, can be controlled carefully is hygienic and eliminates losses due to birds during customary, drying in open yards in the sun.

Before feeding the paddy to the parboiling unit, it is desirable to remove the chaff, dirt and other impurities in paddy by passing it through a paddy cleaner. A further improvement could be to wash the paddy with water in a separate washing system to remove even the adhering dirt; this can also be adopted to remove stones, etc. from the paddy. In such a case, the washed paddy will have to be directly charged into the parboiling tanks.

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Colour of the parboiled rice. Factors contributing to the colour of the parboiled rice are (1) pigments of the bran especially in the reddish variety of rice and (2) the time and severity of heat treatment given to the rice during parboiling. The longer the heat treatment and the more severe it is, the greater the yellow tint in the finished rice. A large section of consumers especially in Kerala are said to prefer a marked yellow colour in the rice. The hot soaking method gives a product which has a shade deeper than that obtained by the customary cold soaking methods. The practice now employed to induce yellow colour in the rice by keeping the steamed parboiled paddy overnight or even longer (this incidentally brings about an enhancement of the fermented smell) is not necessary in the modified method because the paddy will already have been subjected to heat treatment during the process.

Rice of a lighter colour can be made by reducing the temperature of the soak water to 60°C. and increasing the soaking time to about 8 hours or so. An overnight soaking at this lower temperature could also be practised to adjust it to the mill schedule of restricting soaking to the night and drying in the sun during the day. This will give a fully gelatinised rice of light colour. If the soaking time at 60°C is reduced from 8 hours to 4-6 hours, a partially parboiled rice with a white core, somewhat opaque and resembling raw rice in appearance can be obtained.

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This type of parboiled rice is a speciallty product and will be in great demand from that section of the population who would prefer a white coloured rice with the same nutritive value as that of parboiled rice. However the processing has to be done with care and would be limited to the hard varieties of rice that do not undergo much breakage during milling.

Advantage of the improved method of parboiling: The following are the advantages of the improved method over the customary methods: (1) There is a reduction in soaking time from 2-3 days (as in the cold soaking method) or one day (as in the double boiling method) to 4-5 hours only. This considerably reduces the processing time and makes for larger production. (2) The bad smell is entirely eliminated. (3) The microbial load on the steamed paddy after parboiling is very much less as compared with that in the customary methods. Hence, even if the paddy were to get slightly wet during the drying process as a result of sudden onset of rains, the development of bad smell due to microbial spoilage is much delayed in paddy parboiled by the improved method. The danger of microbial toxins developing in the rice during the prolonged soaking process is eliminated (4) Rice can be prepared at short notice depending upon the market demands. (5) There is a quicker turn over of capital invested on the paddy. (6) Yellow colour can be easily obtained in the

rice to suit the needs of customers (7) there is a saving in labour charges in the improved method. (8) the water requirements in the method are smaller than in the cold soaking method as frequent changes of soak water are not necessary. (9) the yield of rice in the improved method is reported by rice millers to be about 1% more than that of the customary methods. Breakage during milling is also reported to be less.

Parboiling of paddy is practically not resorted to in the region; though it is increasingly being carried out in other rice growing areas in the country. Taking into consideration the qualitative as well as quantitative advantages, it is essential to set up (i) an improved par boiling unit, (ii) mini rice mill and (iii) rice bran stabilization unit. For demonstration purpose, one each in Bhandara and Chandrapur districts, by Development Corporation of Vidarbha Limited. This will enable the introduction of parboiling, mini rice mills and rice bran stabilizers at suitable places in the region.

Manufacture of beaten rice (Poha)

Amongst the rice prpducts, beaten rice or poha is a single product prepared and consumed to a large extent in the region. The paddy is soaked in warm water (60°C) overnight. It is then roasted over hot sand in a bhatti. The flaking is done in an edge - runner type flaking machine. The yield

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of Poha in this process is only 50 to 55% which is very low. This traditional process needs improvement in regard to (1) The degree of gelatinisation of starch during soaking and roasting treatment will have to be controlled so that cooking is complete (2) The roasting step, which is a batch type and labour intensive has no precise control. It has to be mechanised and the use of sand has to be eliminated to avoid grit into the finished product. (3) The low yield is due to the inefficient flaking and high breakage. Replacement of the edge-runner type flaker with a suitable machine is required. (4) Reduction in the processing cost is desirable; by making it continuous if possible, besides streamlining the process. (5) The product needs to be handled and packed in moisture proof containers to avoid its becomming tough and leathery on keeping.

Research work on the above aspects is in progress at the Central Food Technological Research Institute, Mysore and the preliminary findings in these regards are as follows:

1. The bhatti can be replaced with a mechanical roaster and the edge-runner by heavy flaking rollers. The use of heavy flaking rolls for poha making has been standardised. The indigenous poha machine of the edge-runner type was found suitable for the flaking of Sorghum (jowar) and Bajra. (2) The cost of production is about 25 paise per kg. The work will be completed in March 1979.

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Puffed paddy (Kheel or Lahi): Puffed paddy or burnt paddy or Lahi is another traditional product which is less commonly used than pohe. It is prepared by roasting paddy to the stage of bursting, i.e. splitting the husk open. The puffed material has an uneven surface and fine sand particles get deposited on it. It can be consumed more widely if the grit is removed and the rice is cooked or gelatinised by pre-treatment. Its increased production should be encouraged because it is a method of using the entire rice without removing any bran. Research work for the improvement of traditional process for making puffed paddy is therefore essential.

Object of the processes: Traditional method for making the above preparations in the household require laborious and time consuming procedures. In the case of Idli and Dosai the raw materials have to be wet ground and allowed to ferment overnight. Similarly the Jilebi batter should be fermented while the vadai flour has to be wet ground manually. The production of ready mix flours for these products would, therefore, save time, labour and sometime even cost to the householder. It also enables him/her the use of a stable hygienic product which gives eatable products of standard uniform quality. Thus the mixes would be of use for urban consumers, middle class families, industrial labour and for catering establishments and also to the sophisticated class of society.

Process: The process involves unit operations like cleaning, grinding, grading, mixing and packing - all involving dry operations. In the case of Idli, Dosai and Vadai, the raw materials like rice, blackgram dhal etc. have to be ground to the required degree of fineness and sifted to remove coarse as well as very fine particles. The process for Jilebi and Jamun involves mixing of ingredients and final packing only. All raw materials will have to be fumigated to kill insect eggs, etc. and preserve them without further infestation. Rice and blackgram mixes are fermented for 18-24 hours depending on the ambient temperature. Fermentation is negligible below 15°C. In order to avoid the dependence on weather and to get idli and dosai without having to ferment the batter, instant mixes which have been chemically leavened have been developed.

There are a number of other products based wholly or in part on rice for which ready mix flours or ready to use formulations can be developed. Such products are crispies, papads and muruku or chakli. Available knowledge can help in simplifying age old practices so that products of improved quality can be obtained and marketed. At present these products from rice are not very popular in the region.

Fermented products: Idli and dosa are the main products in this category. They are made by fermentation of rice and blackgram mixtures in varying preparations.

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Allied industries: Active carbon from rice husk

Regional Research Laboratory, Hyderabad, has developed a process for manufacture of high grade active carbon from rice husk. The plant has a capacity to manufacture 600 tonnes per year (300 days) at the rate of 20 tonnes per day (3 shifts).

Pre-design cost estimates are:

1) Land and Building	Rs. 1,80,000
2) Plant	Rs.14,65,000
Total	Rs.16,45,000
3) Working capital (90 days direct cost)	Rs. 5,55,000
	Rs.22,00,000

Cost per tonne - Rs. 2,753.25

Gross return on investment - 34%

Sodium silicate is obtained as by-product which finds ready market in soap, paper and other industries.

Wheat

A simple milling process for preparation of different wheat products for use in the bakery goods and traditional foods

Using readily available low cost indigenous equipment like huller and chakki (disc mill), a laboratory process has been worked out for the preparation of (a) different types of wheat flour suitable for preparation of chapati/roti, bread and biscuits, and (b) semolina (soji) of different fineness required for the preparation of traditional sweet and savoury snack items.

The different milled products can meet the requirements of household consumers as well as small bakers. The main advantages of such a simple milling process are its relevance for adoption in rural areas in view of small scale operation, low capital investment, and flexibility in operations for milling the required quantity of flours or semolina of desired quality with maximum utilization of the wheat grain (to the extent of 95%). Further studies relating to improvement in the quality of milled products as well as increase in the milling capacity are in progress.

Dry as well as moist heat processing conditions have been worked out to stabilise the germ by inactivating (partially or completely) lipase, lipoxidase and proteolytic enzymes responsible for extremely poor shelf-life (2weeks) of raw germ. Appropriate treatments of germ and packing it in cans, HDPE or polycel pouches increased the shelf-life to about 6 months.

Different heat treatments improved the PER from 2.33 of raw germ to 2.47 of toasted germ, and 2.65 of steamed germ, as compared to 3.00 for milk proteins. The available lysine in germ recorded a decrease of 2 to 10% only, depending on the heat treatment given for stabilisation.

Only steamed germ could be included in laboratory recipes upto 20 and 10% for biscuits and bread respectively, without adversely affecting their quality profile.

A simple and acceptable formulation for a traditional snack based on germ and jaggery has been worked out. Preliminary experiments have indicated the possibilities of preparing acceptable drum-dried product based on germ.

Quality evaluation of Triticale and its suitability for the preparation of Chapati, bread and biscuits

The quality of the eleven varieties of Triticales grown at three agricultural stations of ICAR, were evaluated for their physical, chemical and baking characteristics. The grains of all the varieties were highly shrivelled. The pearling index of triticales was generally high, thereby indicating the softer nature of the grain with respect to milling. The optimum level of moisture for conditioning was found to be only 12%. The yield of flour from triticales ranged from 45 to 66% with an average of only 57%.

The Triticales had higher (450 mg maltose/10 g) sugar content than that of common varieties of wheat (220 mg/10g). The α - amylase activity of Triticales, as indicated by the falling number, was also higher.

The average protein content of Triticales was 12.97%, while that of triticale flour was only 10.8%. Both the averages of wet gluten contents (25.3%) and sedimentation values (19.2 ml) were low, indicating thereby the deficiency of the quantity and quality of gluten in Triticale flour.

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The water absorption of Triticale flour (55.3%) lower than that of wheat flour (63.8%). Similarly, the development time and stability of the dough from Triticale flour were very poor.

It was found that a reduction in fermentation time to 2 hours from the conventional $2\frac{1}{2}$ hours was necessary in the case of Triticale for the preparation of bread. Triticale bread had significantly lower loaf volume (330 ml). Blending of Triticale with 25% wheat flour improved markedly its volume and acceptability of the bread.

Most of the varieties of Triticales were suitable for the preparation of biscuits, which were graded as "Good" as compared to excellent biscuit prepared from soft wheat. Similarly, Chapatis prepared from Atta of six out of eleven varieties of Triticales were satisfactory.

As compared to other non-wheat cereals, and millets, Triticale flour is better suited for blending it with wheat flour for the preparation of bakery products, whereby wheat supplies can be extended.

Storage of food grains: After harvesting, a large quantity of food grains (more than 70%) is stored in rural area for a period ranging from 3 to 8 months. Damage to stored food grain is caused mainly by insects, moulds and rodents, and it is estimated that these losses range from 10 to 15%. The qualitative losses would be more because insects consume

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the most nutritious portion of the grain and render them insanitary due to contamination with body fragments and excretary products, such as uric acid. The Central Food Technological Research Institute, has developed new control methods and improvements in storage techniques particularly useful in rural areas.

Pre-harvest prophylaxis: Prevention of Food losses must start right in the field. The application of Malathion in the form of sprays (below 8 ppm) offers a very effective pre-harvest prophylaxis, specially against the weevils and beetles. The insect infestation in food grains can occur from external and internal sources and has to be controlled at its source.

(A) Conservation of producuers stock

(1) Insect proofing of jute bags: Jute bags are extensively used in the region for handling, transport and stprage of food grains. These can be penetrated easily by pests; and offer insufficient protection for food grains stored in it. A specially formulated emulsion has been developed by the Institute for pest-proofing jute bags. The jute bags treated with this inexpensive emulsion protects the grains effectively by preventing the entry of insects in them. The emulsion does not affect taste, colour, luster and germination of grain or damage the jute fibres. A simple portable machine has also been designed by the Institute for spraying the emulsion over the empty bags. The effectiveness of this spray lasts for 8-10 months. The machine costs about Rs.7000/-

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and can treat nearly 400 bags per hour at a cost of only 50 paise per bag. For treating filled and stacked bags, another low cost emulsion has been developed for spraying them. This has efficacy against insects for 4 to 6 months and rats for 3 months. These techniques are being employed by a number of pest control operators.

Precautions: Pest proofed bags should not be used for flour, soji, vegetable, sugar and any other powdered material.

2. Non-toxic grain protectant: A development of particular interest to rural areas is the use of non-toxic activated clays at 0.5 to 1.0% level, for infestation control of food grains. The activated clays have no harmful effects on man or environment, and are thus safer material for use. The specially treated Kaolinic clays (acid activated) removes the waxy coating from the insect body and causes death of the insect by quick dehydration. The grain protectant is inexpensive and can be widely adopted as it involves only mixing of the clay with the grain.

Milled grains and flour can be protected against insect by adding 0.2% tri-calcium phosphate mixture with pyridoxine and glucose. Tri-calcium phosphate which is food additive is non-toxic to human beings but exerts its toxicity to insect pest of stored grains. These findings have opened new possibilities in the areas of pesticides and pest control.

(B) Conservation of commercial stocks: Hardly 30 per cent of the food grains produced in the country come out of the farm and enter in to organised trade channels for marketing as a marketable surplus. The loss of food grains in this sector is estimated at 6 to 10% during handling, storage and distribution under urban storage condition. Fumigation with gaseous chemicals is one of the most efficient methods of disinfection. .

Durofume process: Food grains packed and stored in gunny bags commercially in bulk can be effectively fumigated by using mixtures of ethylene dibromide and methyl bromide. The proportion of these fumigants in a mixture varies with the commodity to be fumigated. The process of fumigation employing a mixture of EDB and MB, developed by Central Food Technological Research Institute, is called the durofume process. The mixture can be administered from cans or gas cylinder and is very effective in destroying both adult as well as egg stages of insects present in the commodities. The fumigant leaves little or no residue and its application is safe. The cross infest tion over extended periods can be arrested only by insect proofing of jute bags. The durofume process is being used by over 20 pest control organizations on a commercial scale in the country.

(C) House-scale fumigation: A fumigant tablet called "Minifume tablet" has been developed by CFTRI to disinfest cereals, pulses, and seeds (excluding oil seeds) stored in

domestic or rural stores. The fumigant ethylene di-bromide is absorbed on cardboard in tablet form, and is packed in laminated aluminium foil in a stripped form. Each tablet can fumigate 100 kgs of food grains stored in bins, drums, pots and bags in small quantities; and costs 50 paise. The method of using minifume tablet is very simple and the fumigation does not affect the quality of the grain or the germination.

(D) Insect control in industry

1) Infra-red heat treatment: Processed foods like breakfast cereals, dehydrated fruits and vegetables, etc. require protection from insect infestation. Many of these commodities cannot be fumigated with commonly available fumigants due to their residual limits. An infra-red heat treatment has been developed by CFTRI for disinfestation of some of these processed foods. In this method, the processed food is continuously passed through rotating stainless steel tubes heated by a battery of infra-red bulbs. The equipment can be installed in the factory for disinfestation of processed foods prior to packaging.

2) Serial fumigation technique: Packed condiments and confectionary products require disinfestation prior to despatch. In this technique, air-washing, employed in the vacuum fumigation installation has been used with better advantage. The air-washing serves the dual purposes of removal as well as transfer of the residual fumigant; and is used in series for subsequent fumigation. If quicker fumigation is required, only the depleted level of the fumigant may be added.

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(e) Microbial insecticides: Encouraging results have been obtained at the Institute on control of certain types of insects (moths) on food crops and stored commodities by a product based on the spores of Bacillus cereus var. thuringiensis. Addition of 1 ppm spores in wheat, flour and paddy reduces the requirement of malathion considerably.

(f) Lindane: Lindane is widely used in agriculture, public health and food grains disinfestation specially for spraying the jute bag surface. An economical process for production of Lindane needed for a host of pesticidal formulations has been developed from Benzene Hexachloride and the know-how has been given to 12 firms. Coincident with this development is the recovery of a by-product after isolation of Lindane which has also insecticidal properties and can be used for control of termites and pests of cotton and other commercial crops. Commercial production of Lindane has started recently.

Rodent control: The rodents consume certain quantum of food and contaminate the rest by bringing in filth as well as micro-organisms. They breed at a prolific rate and grow very rapidly. It is estimated that 6 rats consume the food of one person every day. They mature at the age of 3-4 months and probably continue to breed upto the age of 18 months. The period of gestation is about 21 days and the females come into heat every 5th day and can breed within a day after littering. Very often, the young ones are weaned at 3 weeks just prior to the arrival of another litter. The female averages 5-7

litters per year of 8 to 10 young ones each. Some Indian estimates based on field studies have indicated that there are about 2400 million rats in the country. This indicates the enormity of the problem which rodent population has posed in the country.

An integrated approach is also necessary to overcome rodent menace to food stocks. This will require burrow fumigation, rodent repellency from the foodstocks and poison-baiting. Better storage designs befitting the requirements of the rural conditions both from practical and economical point of view have been developed and the information is available for application. These designs have already been tried out under different conditions and found to be quite successful (Table 6).

Table 6

Applicability of the processes and products developed by the CFTRI, Mysore for infestation control under the tropical countries

Problem areas	Application of processes or products
A. Pre-harvest	Pre-harvest prophylaxis by: 1. (i) Spraying of Malathion formulation on grains or pods (ii) Bacterial insecticides on paddy and vegetables 2. Rodent control in the field 3. Insect-proofing of gunny bags 4. Insect-proofing of structures 5. Rodent control techniques for dwellings;

contd ...

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	a) Repellent spray; (b) Baiting with attractance; (c) Fumigation of burrow with emulsions.
	6. Spot fumigation with ethylene dibromide tablets
	7. Mixing of activated kaolin with pulses or legumes.
	8. Nutritional grain protectant on rice, wheat, protective foods, processed cereal foods, breakfast foods, etc.
C. Commercial warehouses	9. Durofume process
	10. Balooning process
	11. Rodent-proofing of structures
D. Food processing factories	12. Heat disinfestation
	13. Serial fumigation technique
	14. Nutritional grain proctants
	15. Multiple fumigation process
	16. Insect and rodent-proofing of cartons and packages.
E. Household	17. Household sprayer and pest-proof emulsion, Repellent formulations
	18. Fumigation tablets, paste and powder
	19. Calcium phosphate based on grain protectants
F. Pesticide industry	a) Lindane b) Insecticidal clay c) Bacterial insecticide d) Durofume formulation e) Pest-proof emulsion f) Gas-mask canisters g) Non-toxic insecticidal product h) Repellent cake, liquid, cream i) Rodent baits
G. Servicing firms	1) Designs of pest control equipment 2) Pest-proofing machine 3) Durofume equipment 4) Rodent control kits 5) Training course

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Although the developments made so far in the country have laid the basis for establishing a infestation control industry, the real impact in terms of stretching the food supplies can be felt only by adopting them on a national scale in village storages. This requires establishment of demonstration-cum-field service centres in various regions and a substained campaign through various channels of communication.

Maize (Zea mays)

Production of maize was to the extent of 900 tonnes and 600 tonnes in Chandrapur and Buldhana districts respectively (1973-74). With this limited production of maize, it may not be possible to establish a maize mill but as and when the production subsequentially increases it could then be considered. However, setting up of a unit for the manufacture of corn flakes of a capacity of one tonne/day in these two districts may be considered.

Corn flakes: (i) Outline of the process: Corn flakes is a populat breakfast food among the well to do sections of the people particularly in the cities. Current production of corn flakes in India is about 3000 tonnes. Maize is cooked with steam in a rotary cooker, required quantities of sugar, salt and malt syrup are addedand the material sent to a hot air dryer. Dried material is then flaked in a flaking machine. The investment required for a unit is as follows:

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Land & Building and warehouse	- Rs. 2.0 lakhs
Machinery & Equipment	- Rs. 9.0 lakhs
	Rs.11.0 lakhs
Working capital	Rs. 3.0 lakhs
Annual turnover	Rs.25.0 lakhs

6.2 Pulses: CFTRI has developed a modern dal mill employing new technology for improving the yields. It consists of conditioning the pulse to loosen the husk, removal of husk in a specially designed dehusker, followed by spilitting into dal. All the operations in the modern dal mill are independent of climatic condition. Adoption of this technique would add by about 10% more to the present pulse supplies in the region. The existing pulse milling industry in the region consists of 46 registered dal mills, with an installed capacity (in terms pr production value) of Rs. 4,84,31,900. Due to lower yields these mills are not being utilized to full advantage. A programme has therefore to be initiated by the Development Corporation of Vidarbha, for modernising the existing dals mills in a phased manner. The investment needed for providing conditioner, pearler and splitter, would be Rs. 50,000 per mill, and adequate provision for funds may, therefore, be made for this purpose by the DCVL. The first modern dal mill has been fabricated and successiully tested recently by M/s. S.K.Engineering & Allied Works, Sheonagar, Bahraich-271801 (UP).

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The modern dal mill has a capacity of 8 tonnes per day and requires, total capital investment of about Rs.4.06 lakhs; comprising of Rs. 1.96 lakh as fixed capital and Rs. 2.1 lakh as working capital. The conversion cost per tonne of dal is Rs. 50.6 .

Papad making: Analyses of 31 varieties of commercial samples of papad done at the Institute has shown a wide variation in its physico-chemical and organoleptic characteristics. The defects observed are (1) high alkalinity (7 samples) and (2) excessive number of holes, foreign matter on surface of raw papad, foamy oil deposit on fried papad (together in 5 samples). Physico-chemical characteristics of papad khar and its role in dough characteristics and the papad have also been studied. Papad khar could be conveniently replaced by food grade carbonates to avoid variation in the quality of papads. Analysis of commercial papads indicates wide variation in the quality of papads. Analysis of commercial papads indicates wide variation in average weight (3-25 gms) diameter (6-24 cms), thickness (0.2-1.5 mm), moisture (9-17%) ash (4.8-11.4%), and insoluble ash (0.2-1.5%), alkalinity expressed as sodium carbonate (0.3-3.8%), pH (5.2-9.1) and protein 18-22%). The main ingredients in papads are blackgram and greengram and in some cases the spices used are chilli or pepper. Papads are also made from sago. Papad is moisture sensitive and therefore requires protection against ingress of moisture. Though hermetically sealed container is an ideal

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Package, it proves to be uneconomical. The equilibrium moisture content of papads at 27°C at 63% and 75% RH is found to be 14% and 20.57% respectively. It is known that when the ambient relative humidity is above 70% papads are susceptible to fungal spoilage. From the ERH studies it is observed that a moisture content of about 13% would be critical for papads in regard to mold growth. A 250 gauge polyethylene film package for a 1/2 kg unit pack,has a shelf life of 120 days at 27°C and 92% RH. In the trade a overwrap of moisture proof cellulose film is given. In such pack the product will have much longer shelf life, sales appeal and may meet the requirements of export trade. About 600 tonnes of papad valued at nearly Rs. 2 million were exported (1967-68) to various countries, but very little has been done to put this industry on scientific lines. Papad making is traditionally confined to the household. In recent years however, it has developed into cottage and small scale industry, papad making on scientific lines offers good scope for developing a small scale industry in the region.

Gram parching units: Split and parched Bengalgram (Dalya) is a popular item among the people. Small mechanised units are available for this purpose. Four such units can be set up in the region, one each in Akola, Bhandara, Nagpur and Amraoti districts at suitable locations.

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Bakeries: Biscuit and bread are consumed by all sections of people. Though there were 60 registered bakeries in the region (1972), most ofmthem appear to be the ones with a capital investment of about Rs.8 - to 10,000 only. It may, therefore, be feasible to set up a unit capable of producing approximately 250 loaves of bread and some quantity of biscuits, one each in Amroati, Akola, Yeotmal, Chandrapur and Buldhana districts. The investment for such a small scale bakery will be as follows:

Land & Building	- Rs. 2.1 lakhs
Plant and Machinery	- Rs. 2.8 lakhs
Working capital	- Rs. 2.1 lakhs
	Rs. 7.0 lakhs

6.3 Oilseeds: The Institute has done pioneering work for the development of protein foods from oilseed meals particularly groundnut. The diagram below shows the utilization of groundnut for manufacture of protein foods.

Groundnut → Oil cake → Flour
1) Multipurpose food
2) Weaning food
3) Paushtik Atta
4) Bal ahar

Oil → Protein isolate
1) Hydrolysate
2) Infant food
3) Miltone
4) Panir-like product
5) Beverages

The availabilable technology in regard to the protein foods from groundnut is described in beief.

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1. Edible grade groundnut cake: Oil seeds are being cultivated mainly as a source of oil. Oilseed cake is being used mostly as cattle feed or as fertilizers. Recent work at CFTRI, Mysore, and other institutes has shown the possibility of use of oilseed cake as a source of protein for foods intended for human consumption. The oilseed cake with a protein content of 50% could be a very cheap source of protein. At present, the available amount of oilseed cake from groundnut has not been fully utilised for human foods. This is more because of the non-availability of edible flour prepared under hygienic conditions. The estimated requirements for 1973-74 for incorporation into products like Balahar at 15% level is of the order of 22,500 tonnes, and the demand is expected to go upto 37,500 tonnes by 1975. Groundnut flour is also being used for production of fortified atta. The annual requirement for 1973-74 at 5% level of fortification is in the order of 3,000 tonnes and is expected to go upto 20,000 tonnes by 1979. The advantage of using groundnut flour as a source of protein is the fact that the protein in the groundnut is not associated with any inherent anti-nutritional factors and being bland it blends easily with different types of food products.

2. Outline of the process: The groundnut is shelled, to remove husk, cleaned to remove stones and graded to remove infested seeds. Then the nuts are roasted and blanched to remove red cuticle and germs. The decuticled seeds are hand-picked for removal of discoloured and fungal infested seeds. The food

clean white kernels are subjected to breaking and cooking to condition the kernels for oil extraction. The cake from the expeller is flaked and solvent extracted using food-grade hexane. The decoiled meal is desolventised and groundnut flour for packing.

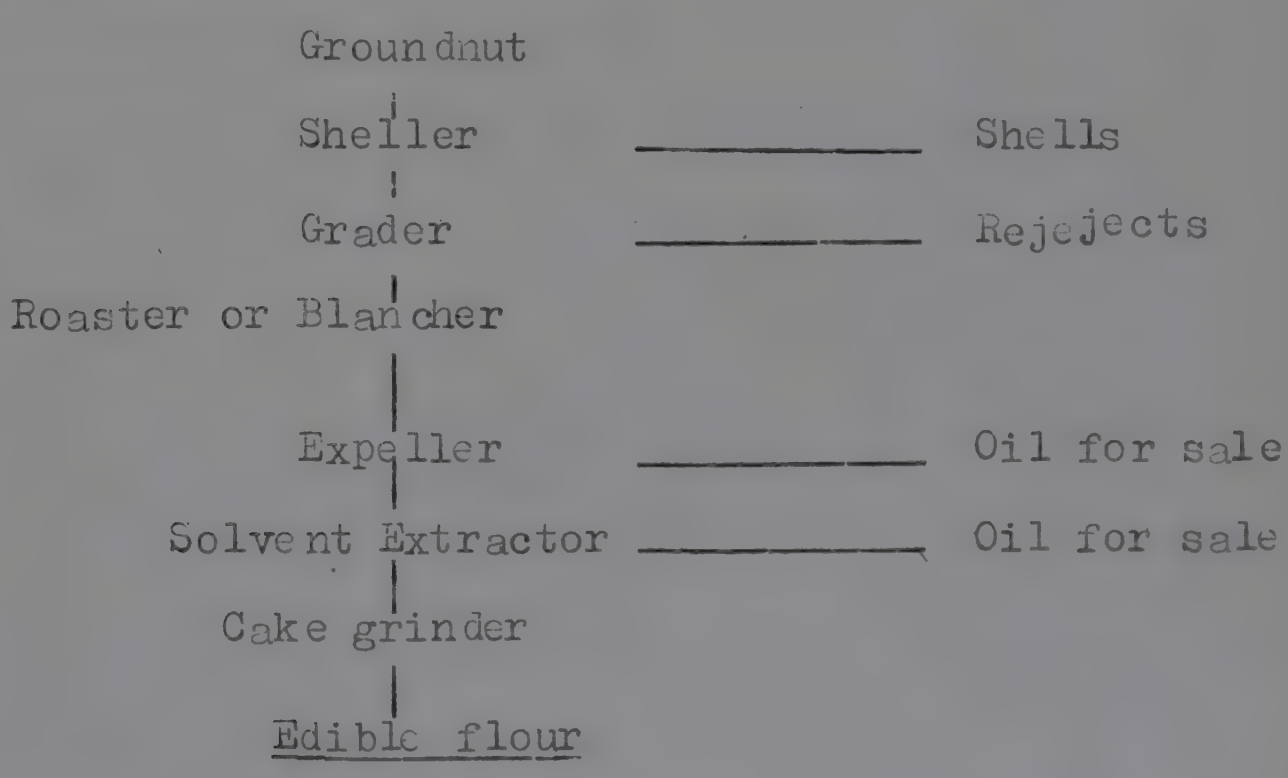
3. Design basis: (a) Product standard

Protein content	Min. 50%
Oil content	Max. 1%
Fibre content	Max. 7%
Moisture	Max. 7%
Sand and silica	Max. 1%
Aflatoxin content	Max. 50 parts per million
Particle size	100% to pass 100 mesh

(b) Raw material standard

Groundnut - Oilseed quality max. moisture 7%
Hexane - Food grade

4. Block diagram of the process



5. Plant capacity

Groundnut (in shell) handled	9000 T/Y
Expelled oil for sale	2670 T/Y
Solvent extracted oil	225 T/Y
Edible flour	2940 T/Y

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6. Raw materials and utilities

Groundnut in shells	30 tonnes
Solvent hexane (for losses)	240 litres
Steam	13000 kgs
Electricity	1600 KWH

7. Plant area

35 m c 70 m = 2450 m^2

8. Investment

Land and building	Rs. 4,20,000
Plant and equipment, erection, etc.	Rs. 13,80,000
Working capital	Rs. 20,00,000

Manufacture of raw, roasted, deep fat fried/salted groundnut seeds

There is a considerable demand for edible quality raw, roasted, deep fat fried/salted groundnut seeds for use in food preparations or consumption as snack foods. These products can be sold in consumer packs both locally as well as in cities and towns. A model unit with a capacity of 10 tonnes of finished product (cleaned seeds, de-cuticled and roasted kernels) is considered as an optimal size unit.

Investment:

1. Land and building	Rs. 2 lakhs
2. Plant and machinery	Rs. 8 lakhs
3. Working capital for 100 days	Rs. 20 lakhs
Total	Rs. 30 lakhs

Indian Multipurpose food

The Central Food Technological Research Institute (CFTRI), Mysore have developed an inexpensive, concentrated, food supplement to balance deficient diets. Called the Indian

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Multipurpose Food or MPF, the food is prepared from specially processed groundnut meal and Bengalgram flour, with added vitamins and minerals.

Composition: MPF is primarily intended to supplement the diet of children and expectant and nursing mothers, but can be used with profit by all. 100 gms of the MPF provides 360 calories and the following nutrients indispensable for the normal growth of children and well-being of adults.

Protein (g)	43.2
Calcium (mg)	684
Phosphorus (mg)	842
Iron (mg)	5.4
Vitamims A (IU)	2085
Vitamin B1 (mg)	1.44
Vitamin B2 (mg)	14.4
Vitamin D (IU)	256
Nicotinic acid (mg)	14.4

Bulk for bulk, the Indian MPF supplies twice as much of protein and 4-6 times as much calcium, thiamine and nicotinic aci as Bengalgram or several common Indian pulses. It is also a rich source of riboflavin and vitamin A and D in which the pulses are deficient. Daily supplementation of diet with 57 g of MPF significantly improves the nutritional status of the consumer. Recipes for using MPF in a variety of popular food preparations have been formulated.

Two types: Use of MPF requires no change in food habits. It is available in two types as spiced (or seasoned) MPF,

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with added salt and spices, or as plain (or unseasoned) MPF, without being spiced. The spiced MPF can be used as a chutney powder, or cooked along with other ingredients for making dishes like uppumav or khicheri, vegetable curries and dhal soup. The plain MPF can be made into a a pudding, cooked into a porridge, with or without milk, combined with wheat flour to make chapaties or fulka, or incorporated into sweet dishes to reinference their nutritive value.

The proportion of MPF used in combination with other foods should be about 10% so as not to alter in any way the taste or texture of accustomed foods.

Large scale manufacture: The Institute has a small production unit with a capacity of half a tonne of MPF per day. Four units located in the State of Gujarat, Karnataka and Uttar Pradesh are producing MPF under the technical advice of CFTRI.

Weaning foods

Weaning foods are specially intended to meet the protein needs of children after the weaning period in the age group of 6 months to 4 years. As they are high protein foods, they could also be used as supplement to the diets of school children and adults. The blends that have been tried are made from groundnut flour, pulses and cereals. Greengram, Bengalgram could be used as the source of pulse protein. Pulses have been used because of their high lysine content and also because of their highly acceptable taste. Generally

these weaning foods are low in sulphur amino acids. Supplementation of these foods with a small quantity of methionine usually enhances their protein value. The general method of preparation of these foods have been as follows:

The blend is dispersed in cold water and is cooked to some extent in a steam kettle. The cooked mash is pumped on to a roller drier. The dried flakes are passed through a sieve and packed either in tins or polythene bags.

The protein efficiency ratio of these foods is about 2.2 to 2.3. With addition of methionine it is enhanced to 2.5. The weaning foods reconstitute into a smooth porridge when mixed with warm water in the ratio of 1:6. They have a good shelf life.

Bal Amul, a weaning food, produced and marketed by the Kaira Dist. Co-operative Milk Producers Union Ltd., Anand. Amul is based on the technology developed by the Institute. Two other firms are expected to go into production shortly using other formulates of the institute. The anticipated expenditure for about 3 tonnes per day capacity is as follows:

1. Land and building	Rs. 5 lakhs
2. Plant and Machinery	Rs.17 lakhs
3. Working capital for 100 days	Rs.15 lakhs
Total	Rs.37 lakhs

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Panchtik Atta: This is a blend of 75 parts of wheat flour, 8 parts groundnut flour and 17 parts tapioca (Cassava) flour. The nutritional value of this blend compares very well with that of whole wheat flour. The flour is readily acceptable to the consumers when prepared into chapati or poori.

Bal Ahar: Bal Ahar means a nutritious food for children. It is a blend of high protein foods like oilseed cake flour, pulses flours and cereal flours. The protein content of the blend is to be maintained between 22-26%. The food is fortified with vitamins and minerals. For serving to children it is usually cooked with about 7 to 8 times of water and fed as a gruel. Also it can be served to children in the form of chapati, puri, halwa and so on. It comprises of:

Whole wheat flour	65 parts
Groundnut flour or cottonseed flour	25 parts
Bengalgram	10 parts

The Food Corporation of India on behalf of the Food and Nutrition Board, Govt. of India, has taken up its manufacture for nutrition programmes. Its production in 1972-73 is reported to be 25,000 tonnes and the potential demand in next few years is about 85,000 tonnes.

Protein isolate: It is now recognised that isolated oil seed proteins offer immense possibilities in the development of a new class of formulated foods for human consumption. The high concentration of protein with advantage in colour, flavour and physico-chemical properties makes protein isolate

ideal raw materials for protein based food industries. In our country it offers great scope for use in acceptable forms of processed foods, milk foods for infants and chikdren and certain types of speciality foods, such as baked products, cheese like products and ice-creams, etc.

A semi commercial plant with a through part of 500Kgms of groundnut per hour was designed and erected at Bombay by this Institute with the collaboration of NRDC of India and the Tata Oil Mills Co.Ltd., Bombay. It is based on wet rendering of seed materials for simultaneous separation and recovery of fat and protein in a single process. Isolation of the protein does not result in lowering the nutritive value of the proteins (present in the raw material). The PER of the isolated protein (1.40) is nearly the same as that (1.47) of proteins in groundnut flour.

M/s. Tatas are at present manufacturing the groundnut protein isolate on a semi-commercial basis. At the full working capacity of the plant, the ex-factory price of the groundnut protein isolate would be Rs. 14.0 per kg.

Infant food: In view of the scarcity of milk, this Institute has prepared an infant food formulation from a blend of groundnut protein isolate, dextri-maltose, vegetable fat and skim milk powder, fortified with vitamins and minerals. The product is comparable in composition and nutritive value to infant milk foods and is found to be highly acceptable.

Milk: Milk is an essential food item, being one of the primary sources of good quality proteins and other nutrients. The present milk production totalling about 23 million tonnes annually, is hardly sufficient to meet even the barest requirements of a country with a population nearing the 600 million mark. Whereas milk consisitutes the main food for infants, it is also essential to adults especially vegetarians.

The enhancement of the present production of milk is limited because of a variety of factors such as availability of land and water and adequate facilities for transport from areas of production to centres of consumption. Only alternate step, to meet the requirements of 20 million infants, growing children and other vulnerable groups without curtailing the needs of other segments of population, is to extend the available milk supply by using either imported skim milk powder or vegetable protein isolate. Since a modern technology has been developed by Central Food Technological Research Institute, to produce protein isolate from groundnuts, use of this material for toning of animal milk is an attractive proposition provided the product is acceptable to the consumer. As a result of extensive developmental work carried out at CFTRI, an acceptable product can be prepared from commercially available groundnut protein isolate and animal milk.

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A commercial size plant has been established in Bangalore and to-day Bangalore Dairy is manufacturing Miltone to the extent of a few thousand litres a day. The plant has been working for the past several years, demonstrating the usefulness of Miltone in school feeding programmes, in feeding children at welfare centres and also in the Social Welfare Programme of Government of India. It has been amply demonstrated that Miltone could be substituted in the preparation of curds and other similar milk based preparations. It can also be bottled and sterilized.

It is possible to obtain Miltone at a higher concentration of total soluble solids for subsequent dilution to required levels at the distribution centres. Spray dried Miltone can be reconstituted to obtain ready to consume beverage.

Process:

The manufacturing process in brief, consists of extraction of protein solids from defatted groundnut flour followed by its reconstitution to a slurry containing around 12% total solids. This protein liquor is mixed with standardised milk in equal proportions. Butter salts, vitamins and minerals are added and the product is homogenized. Desirable flavour could be incorporated if the product is to be used as a ready to take beverage.

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Production of Malted Beverage Food:

Several types of malted beverage products are available in the market. However, all these products contain milk and some also contain cocoa. In India, no industrial organization is manufacturing malted beverage foods based on vegetable proteins. The use of vegetable proteins instead of milk and cocoa for making beverages is a new approach. The advantage is that the industries need not depend upon the use of milk which is in scarce and on cocoa which is an imported commodity. The product developed at CFTRI is based mainly on vegetable protein, vegetable fat, and synthetic chocolate flavour. The product is similar in nature and taste to other beverages such as Ovaltine, Bournvita and Ovomalt.

Outline of the procedure:

Peanut flour is peptised at optimum pH and centrifuged. The pH of protein liquor is adjusted to neutral. Barley malt and wheat flour are mashed and the liquor obtained is blended with peptised liquor from peanut flour. The blended liquor is concentrated in an evaporator. The other ingredients like fat, sugar, carmel flavour, colour, minerals and vitamins, are added to the concentrate. The resulting mixture is whipped in a mixer and spread on trays and dried in a vacuum shell drier. The dried material reconstitutes easily in hot water or

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milk and possess fine malt and chocolate flavour. The protein and fat content of this product are 18 and 7 per cent respectively.

High Protein Biscuits:

Biscuits are a convenient medium for providing protein and other nutrients to children. They generally contain 5-6% protein,

The Institute developed a sweet biscuit containing about 16% protein and adequate amounts of vitamins and calcium. Wheat is partially replaced by edible groundnut flour in this product. A leading biscuit manufacturer launched the manufacture of the product under the trade name Nutro Biscuits.

Subsequently, biscuits with a protein content of about 26% using groundnut flour and fortified with lysine, vitamins and minerals has been developed, and the know-how is being used for commercial production.

About 1500 tonnes of high protein biscuits are being manufactured in the country, based on the Institute's technology.

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High Protein Chewy Candies:

Chewy candies containing about 20% protein, mainly of vegetable origin, have been developed. They can be kept without deterioration for about six months, and can be manufactured using normal candy making machinery.

Coffee and Tea Whiteners:

Two types of coffee and tea whiteners have been developed one is based on groundnut protein and the other contains about 20-30% milk protein. In addition, they contain vegetable fat, buffer salts, emulsifier and sugar.

The whiteners can be used in place of milk for preparing coffee and tea, especially in hotels and catering establishments.

Non-Dairy Ice-Cream:

An acceptable non-dairy ice-cream has been developed based on groundnut protein isolate. The texture, taste and other characteristics are comparable with the conventional ice-creams. The product has a protein content of 7% as against 4% protein in the milk based ice-cream.

Vegetable Curd:

It has been found that lactic fermented vegetable milk from groundnut could be used in the manner as cow's

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milk curd. Vegetable curd has been found to possess a good supplementary effect on the diet of children. About 7-8 kg of curd can be produced from 1 kg of groundnut kernels.

Vegetable Milk Curd from Groundnuts:

Vegetable milk and milk products processed from soyabean are commonly consumed in China and other Far-Eastern Countries. A plant for the production of spray-dried vegetable milk powder known as 'Saridel' has recently been erected at Djakarta under the auspices of the FAO, UNICEF and the Indonesian Government; the estimated capacity of the plant is 300 tonnes per year. These and other similar products are meant to supplement the inadequate supply of animal milk in those regions.

An analogus approach for the processing of groundnut has been made at the CFTRI, Mysore, and the practical possibilities of preparing vegetable milk and curd have been established. The lactic acid fermented curd prepared from the vegetable milk has been found to be an acceptable product. The flow-sheet of the process for making the curd is given below:

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Groundnut	Decotrication		Kernels
Roasting & removal of the cuticle and the damaged kernels	Blanched & selected kernels		Pulveriser
Fine paste	Partially defatted residue	Mixer	Dilution, mixing and filtration
	Partial defatting by skipping process (20% of the paste)		
Emulsion	Steam jacket kettle		Deodorized milk
Mixing tank	Cooling for fortification with minerals and vitamins		Fortified milk
Homogenizer	Stabilised fluid milk		Souring
			Vegetable curd

Manufacturing Process:

Shelled groundnut of good quality are mildly roasted, cooled, and scrubbed to remove the testa and the germ. The clean split cotyledons are made into a paste in a pulveriser (triple roller mill 'mikro pulveriser' or 'kek mill'). The moisture content of the fine paste is adjusted to about 18 per cent by adding calculated quantity of warm water and the paste is kneaded for about 10 mts. The oil liberated is drained off. The partially defatted paste is mixed with six parts of water and filtered to yield a milky emulsion, while mixing with water, saturated lime water is

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added slowly with stirring to neutrialise the acidity; about 1.1 litre of lime water is required per kg. of paste. The emulsion so obtained acquires a faint yellow tinge. The pH of the emulsion is adjusted to 6.8 - 7.0 and the milk is heated to boiling in a steam jacketed kettle. Steam is bubbled through for 30-45 minutes to deodorise the milk. After cooling, the milk is fortified with minerals and vitamins by adding to every litre of deodorised milk, tricalcium phosphate (2.2 g), sodium citrate (1.1 g), riboflavin (2.0 mg), ascorbic acid (17.7 mg), vitamin A (1400 I.U) and vitamin D (200 I.U).

To the fortified and homognised milk is added invert sugar of 55^{o}Brix at the rate of 1 per cent and the milk seeded with cow milk curd (or vegetable curd) at 37-38^{o}C); about 1 kg of curd is required for seeding 100 kg of milk. The quantity of invert sugar and seed curd can be varied according to the acidity desired in the final product. The milk is left at room temperature for 12 hours when it sets to a thick white curd.

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Chemical Composition of Curds:

Constituents	Groundnut milk curd	Cow's milk curd
Protein(%)	3.00	3.30
Fat (%)	3.50	3.75
Carbohydrate(%)	3.07	4.85
Ash(%)	0.80	0.72
Total solids(%)	12.07	12.62
Ca (mg %)	110	110
P (mg %)	102	70
Fe (mg %)	1.47	0.02 - 0.05
Vitamins/Litre		
Riboflavin (mg)	2.00	1.70
Thiamine (mg)	0.65	
Nicotinic acid (mg)	11.10	1.26
Ascorbic acid	17.7	15.9
Vitamin A (I.U)	1400	1320
Vitamin D (I.U)	200	20

REF:- Supplementary value of groundnut curd to the diet of school children (Experimental period - 6 months)

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Factors assessed	Vegetable milk curds			Control		
	Initial	Final	Difference	Initial	Final	Difference
Height (cm)	117	119.4	2.4	117.6	119.2	1.6
Weight (kg)	19.41	10.57	1.16	19.08	19.66	0.58
Haemoglobin (g/100 ml blood)	11.57	11.8	0.21	11.20	11.37	0.17
RBC_6 count (10/cu.mm)	4.25	4.53	0.28	4.13	4.38	0.25
Nutritional deficiency score	5.29	5.14	0.15	6.09	6.57	1.48

Consumer Trials:

Consumer trials conducted on an extensive scale have shown that the product is an attractive, palatable and easily digestible article of food. Vegetable curd offers a practical possibility of fortifying diets with calcium, vitamins and other nutrients. Though the biological value of the vegetable curd protein is inferior to that of animal milk protein, (deficient in methionine), the product is a good supplement to the rice diet. The curd is being regularly used by many in Mysore City and has been found to be acceptable.

Pilot Plant Studies:

Pilot plant trials at the Institute have shown that 1 kg of decuticled groundnut yields 8 kg of curd. The cost of production is estimated at 44 paise per kg. The equipment

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required for preparing vegetable curds can be fabricated in India. The essential items include, decorticator, roaster, pulveriser, stainless steel pans, mixer, boiler, homogeniser and milk cooler.

Peanut Butter:

Best quality peanuts (groundnuts) are selected. After decortication, the kernels are roasted carefully in an open pan or an oven with continuous stirring until they begin to brown. The temperature should not exceed 240°F. when an oven is used. Care is necessary in roasting, for if it is carried too far, the butter will have a darker and burnt taste. If it is under roasted, it lacks flavour and colour and does not keep well. The roasted kernels are separated into halves by rubbing on a sieve. The skin and 'germs' or embryos are then removed. The presence of the germs is liable to cause the butter to go rancid sooner than it would otherwise do and the skins show up as red specks and give a slightly bitter taste. The white kernels are now made into a paste - neither too fine nor too coarse - in a grinder. Before grinding it is usual to add salt (1-3 per cent) and also sugar according to taste. To stabilise the peanut butter solid hydrogenated fats such as Dalda, Pakav, Marvo, etc., are added to the paste upto 2 per cent, the amount depending upon the type of nuts, degree of consistancy and the temperature. The

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mixture is then run through a homogeniser. The composition of the peanut butter is as follows:

Water	-	2 per cent
Protein	-	23.29 per cent
Fat	-	36 per cent
Starch	-	6 per cent
Sugar, etc.	-	6 per cent
Fibre	-	2 per cent
Salt	-	1-3 per cent

There is no necessity of adding any chemical preservatives to the peanut butter. However, some antioxidants are added to stabilise the peanut butter. The butter can be kept in closed jars in a cool, dry place for several months. If it is to be packed in cans, then sterilised metal resistant lacquered cans should be used.

Energy Food:

A recent appraisal of the Planning Commission has shown that by the end of the plan period about 16.5 million children will be covered underschool feeding programme. At the moment school feeding programme is mainly based on a mixture of corn-soya-milk powder (CSM) or Bal-Ahar. The food has to be cooked and given to the children. It has the further disadvantage that as both the products are based on blend of raw materials there is a chance of

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insect infestation and rancidity development. To overcome some of these disadvantages a new type of food has now been evolved at CFTRI.

Nature of the Product:

It has been repeatedly emphasized that Bal-Ahar is a generic name and not a specific one. Thus Bal-Ahar could be a blend of wheat, ragi, jowar or maize and oilseed cakes like groundnut, cotton seed, etc. depending on the locality where Bal-Ahar is produced. Thus in the production of energy food supplements, it has been found possible to blend flours from ragi, jowar, corn or wheat with edible groundnut flour and pulse flours like Bengalgram, green-gram, etc. The protein content is maintained at about 14 to 15% and provide about 394 calories per 100 g. of the material. A typical formulation consists of the following ingredients:

Wheat	-	60 parts
Bengalgram dhal	-	10 "
Edible groundnut cake	-	10 "
Jaggery	-	30 "
Calcium carbonate	-	1 "
Vitamin premix	-	1 "

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Manufacturing Process:

The process for the manufacture of Energy Food supplement is as follows:

a) Pre-cleaning, roasting and powdering of raw material

b) Fortification of vitamins and minerals

c) Blending of flours

d) Packing.

Characteristics of the Product:

The mix has a pleasant flavour and has a very good acceptability. When mixed with water it can be made into a porridge or paste which can be given to children for consumption as such. It can also be used along with other raw materials for preparations like Halwa, Pancake, Chappathi, etc.

Capacity of minimum economic unit:

A scheme for the manufacture of minimum economic unit of 3 tonnes per 8 hours shift is available.

Raw materials:

All the raw materials are locally available. They are cereal flours, edible groundnut flour, dhal flours, jaggery, minerals for fortification. The vitamins have to be imported.

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Utilities:

Electricity for grinding, mixing and roasting. Labour requirements - Rs.150/- per day.

Market:

The energy food is mainly intended for meeting the demands of the Social Welfare Projects in Mid-day meal and Special Nutrition Programmes. However, with improved packing and proper advertisement it is possible to sell the Energy Food supplement also as consumer articles.

Edible Sesame Flour:

Though a rich source of methionine, an essential amino acid, commercially availables sesame cake is not of edible quality. It has an intense black colour and contains a toxic substance. A process has been developed to pretreat the seeds and remove the husk before expression of oil so as to yield a white, acceptable and safe edible flour. The flour can be used in various nutritive blends and also in confectionary and bakery products.

A one-tonne per day plant has been set up at the Institute for production of the sesame protein concentrate for test marketing and demonstration.

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6.4 FRUITS AND VEGETABLES:

1) Oranges:- Wax emulsion 6% (Waxol-o-12) containing ing 500 ppm Benlate-50 has been found to be useful for extending the post-harvest storage life of Nagpur Santra under ambient conditions from 7-8 days to 18 days. The microbial spoilage was less than 5%. Further details are given earlier in Chapter-3. About 20 tonnes of wax coated oranges were exported to Singapore, Dubai, Iran, etc.

2) Citrus Juice Extractor:- CFTRI has designed and fabricated a citrus juice extractor for extracting juice from whole oranges. The juice is free from peel oil which is collected separately. The yield of juice is 30 to 40% of fruit weight. It has a capacity to handle 7000 fruits per hour, and its estimated cost is Rs.1,05,000. Three citrus juice extractors have been sold to fruit and vegetable preservation units.

3) Triple Roller Extractor:- A small scale triple roller extractor has been designed and fabricated for extraction of orange oil from peels. It has a capacity to handle about 2 quintals of peel per 8 hours shift. The yield of oil on fresh peel basis is 65%. The estimated cost of the Triple Roller Extractor is Rs.7000/-.

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4) Carbonated & R.T.S.Beverage containing Orange Juice:-

A ready-to-serve orange drink (plain and carbonated) containing orange juice has been developed at the Institute. Test marketing of the drink in Nagpur market showed that it had wide acceptibility. Small units to manufacture the orange drinks can be started at Nagpur, Amraoti and Wardha to begin with.

Cola type Carbonated drink "77":- The Institute has also developed a Cola type drink named "77" to replace 'Cocoa-Cola' on a national scale. The concentrated base of the drink is to be distributed by M/s.Modern Bakeries Ltd. Intending bottlers of Cocoa-Cola or others having adequate bottling facilities may apply to M/s. Modern Bakeries Ltd., Bombay for purchase of the concentrate, etc.

The Institute has also developed carbonated Coffee and Tea flavoured drinks.

5) Pectin from peels & pomace:- Orange processing waste (peels and pomace) constitute a good source of pectin and the process for its manufacture has been developed by the Institute.

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Banana:

Antifungal Paste:- An antifungal paste developed by the Institute has proved superior to the imported product when used in several shipments of Banana. The bananas were free from fungus growth for a period of 20 days when the paste was applied to the cut surfaces. 8 tonnes of Antifungal paste valued at Rs.2.4 lakhs has been prepared since 1964.

Export of Bananas without spoilage:- The Institute has played a major role in assisting the commercial shipments of Indian bananas to distant foreign ports without spoilage. For this, conditions have been worked out for picking bananas at the ideal stage of maturity, packing and transportation under proper conditions of cold storage, so that decay is controlled for 3-4 weeks of voyage. The fruits transported under these conditions develop normal yellow colour and other qualities on being ripened by smoking or chemical treatment. Using these techniques, several banana consignments amounting to about 30,000 tonnes have been successfully shipped to several countries in West Asia and also to Europe.

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Papaya:

1. Papaya Candy:- Fully mature but unripe fruits are peeled and then seeds removed. The flash is cut into pieces 7.5 cm x 7.5 cm. which are pricked with forks. They are then kept immersed in dilute lime water (15 g. of lime per litre of water) for about 3-4 hours. The pieces are washed 3-4 times with fresh lots of water and the boiled in sugar syrup of 40°Brix. They are left over-night to permit the penetration of sugar into the fruit cells. The diluted syrup is fortified with additional quantities of sugar to raise the sugar concentration to 50°Brix. The process is repeated till the residual syrup strength reaches 70°-75°Brix (with 50% inverted sugar). The syrup is then drained off. The pieces are further cut to the desired size and shape such that the individual pieces of the finished product should be crisp, juicy and almost transparent. The product is also packed in sterilized wide-mouthed bottles or tin cans (with residual syrup filling the interspace) which are then hermetically sealed.

2. Papain from Papaya:- Papain is the whole dried product from the latex of unripe papaya. It contains proteolytic (protein digesting) enzyme and other possible components. There is a good demand of papain within the

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country and there are also possibilities of export; the product is largely used to tenderise meat, beef, etc. for food purpose. Valuable nutrient media for many kinds of bacteria have been made from various meat proteins after digestion by papain; it has also got its use in pharmaceutical industry.

The usual method of preparing papain consists of collecting milk (latex) in suitable containers after making a few longitudinal scratches on the skin of the green fruit while it is still hanging on the tree. The coagulated juice is then spread out evenly and dried rapidly in air or in a vacuum oven, then powdered, scanned and packed. In order to get good appearance and quality of papain, the use of strainless steel knives, containers and vacuum drying is preferred. A brief discription of the actual process is given below:

Papaya fruits on the trees at a stage of maturity of about 3 months after setting, are lanced by giving 1/20" deep 4-6 longitudinal cuts with a stainless steel knife or razor blade fitted in a curved wooden frame with a handle. The latex is collected in suitable stainless steel, aluminium or wooden trays or arecanut spathe held below the tapped fruit. Six tappings in

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the course of 15 days have been found to be sufficient for the purpose. At the end of each tapping, the latex coagulated on the fruit surface is scrapped and added to the batch. The collected latex is passed through 50 mesh sieve to remove extraneous matter, mixed with 0.5% potassium metabisulphite, spread on stainless steel or aluminium trays (0.5 - 1 lb. per sq.ft. of tray area) and dried in a crossflow hot air drier or vacuum shelf drier at a temperature of about 55°C. Vacuum dried product is superior in quality and is easier to remove from the trays due to its porous structure. The dried product is packed in airtight containers and stored in a cool, dry place. It is advisable to keep the product in flake form as powdering decreases the stability of the product during storage. If the consumers insist on having powdered papain, it is better to powder the product just before the despatch of the consignment. In pilot plant trials, an average yield of about 0.25% papain of about 80 BPC (1955) units has been obtained.

On the basis of the work done at the CFTRI, Mysore it has been found that a plantation of 35 acres of papaya is economical to produce 4 tonnes of papain during a period of 3 years. Papaya plant generally start bearing fruits about 6 months after plantation of the seedlings and the fruits will be ready for extraction of papain

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about 3 months later; the plantation is generally maintained for 3 years, papain could therefore be extracted for about 2½ years. The papayas after the extraction of latex can either be sold in fresh fruit market or various products like toffees can be made ripe papayas.

During the first 9 months expenditure will be limited to the raising of the plantation and maintaining it for 3 years will vary from place to place, but on the basis of work done at the CFTRI in 1962, it has been found that this expenditure comes to nearly Rs.1,500/- per acre. The breakup is Rs.750/- in the first year and Rs.375/- each in the second and third year. 500 tonnes of papain valued at 50 lakhs have been manufactured since 1964.

Fruit Juice Powder:- Fruit juice powders are becoming increasingly popular particularly for feeding infants and children. They constitute a rich source of vitamins and are highly palatable. They can also be a utilised for reconstitution into juices having almost the same nutritive value as juices prepared from fresh fruits. The handling, transport and marketing of powders is also more convenient than fruits and their juices. Fruit juice powders are not being manufactured in India at present.

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A process for the production of fruit juice powder from mangoes, oranges and papayas has been developed. The process consists of concentrating the pre-treated juice, mixing with powdered sugar, fortifying where necessary with vitamins, mineral salts, colours, flavours, fruit acids., and subjecting the pasty mass to obtain shrewd/flakes or pellets. Drying could be done in an ordinary cabinet dryer or in vacuum dryers. The dried material is powdered and suitably packed.

There appears to be considerable scope for developing fruit juice powder products in India because of plentiful availabilities of fruits in certain regions at cheap rates during season. Mangoes are found all over India. Plentiful supplies of oranges are available in Vidarbha. Substantial quantities of papayas are also grown in the region.

The method has been found to be equally useful for orange juice and fruit pulps like those of mango, papayas, jack fruit, pineapple, banana and guava. The process covered by Indian Patent No.49590 has been successfully worked out on a semi-pilot plant scale.

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Fruit Bars:- Various types of pulpy fruits such as mango, guava, papaya and banana are available practically in all parts of the country. Pulps from these fruits are at present being processed in the form of canned pulps, juices, nectares, squashes, jams, etc., by the fruit preservation industry. Pulps specially that of mango are also being sun dried on a cottage-scale to prepare the product known as 'Am paper' or 'Thandra' or 'Mango leather'. The present method of preparing mango leather or Am paper by sun-drying mango pulp is not hygienic and as a result the product generally loses its colour and flavour during storage; some times dust and dirt also adhere to the product and insect infestation takes place during long storage. An improved simple method has therefore been developed at C.F.T.R.I., Mysore, to prepare fruit bars from pulpy fruits like mango, banana, papaya and guava either singly or in combination. In this method after peeling the fruit, pulp is extracted through a pulping machine and is dried after mixing with suitable ingredients to the desired level of moisture in an ordinary tray dryer with cross-flow movement of air and working under controlled conditions. The resulting product has been found to have a long shelf-life and a high organoleptic value. The flow-sheet for the process is as follows:

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Fruit (Pulpy variety)

Washing

Peeling (Initial treatment in the case of bananas)

Pulping

Mixing with other ingredients

Heating the pulp blend to the desired level of temperature

Partial cooling and addition of preservative

Tray leading (spreading on trays)

Drying

Cutting

Packing

There is a large and growing demand for products like fruit bars in and outside the country. The process is simple, inexpensive and easy to operate.

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Liquid Fruits:- Fruit products like squashes, juice, cordials and ready-to-serve fruit beverages which are both refreshing and thirstquenching have now become very popular in the country; the production of such products that has increased considerably during recent years is expected to rise further in coming years. The basic raw material for all such soft drinks is fruit juice/pulp. Physical methods such as pressing, pulping, etc., are now used by the processors to get fruit juice or pulp.

Apart from these physical methods employed in fruit juice manufacture, enzymatic hydrolysis can also be used for the extraction and clarification of fruit juices. Fruits contain pectic substances which have the property of binding water that helps to gel formation in products like jams, jellies and marmalades. In plants, these substances are present as pectose, pectin and pectic acid. Some fruits like lime, oranges, pears, etc., need no special treatment to ensure full economic yield of juice, it is not easy to express the juice unless the pectin is hydrolysed. Pectic substances have a tendency to form colloids and this character is lost when they are hydrolysed. Pectic enzyme preparations used in fruit juice extraction often contain protopectinase, pectinase and pectase which break down protopectin, pectin and pectic acid respectively.

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The insoluble proto-pectin along with cellulosic material and ligma forms the cementing material between cells. When this is disintegrated, the cells are freed and the liquid comes out.

Process for the manufacture of pectic enzymes and their application for fruit juices extraction (liquid fruits) have been standardised at the Central Food Technological Research Institute, Mysore. Three types of products namely, (i) Pectinolytic enzyme-mouldy bran (MB) (ii) Pecti-nolytic enzyme concentrate (PEC), and (iii) Pectinolytic enzyme powder (EP) have been developed.

The process of manufacturing the enzyme consists of growing the selected strains of fungi on suitable substrates like rice bran or wheat bran under controlled conditions for a specified period of time. The mouldy bran which contains the enzyme is dried under controlled conditions and used as enzyme source. The enzyme can also be extracted and concentrated or purified by fractional precipitation.

Detailed investigations have been carried out for utilising guava (Allahabad variety) and banana (Cavendish variety) fruits for producing liquid fruits by the use of pectolytic enzyme developed at the CFTRI, Mysore. The

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process consists of pulping the fruits (after deskinning in the case of banana) and then warming the pulp upto 50 to 60°C to inactivate the enzymes and to prevent pre-microbiological spoilage (whenever necessary, adequate quantity of permissible preservative may be added to prevent microbiological spoilage). After cooling to room temperature, calculated quantity of enzyme is added to the pulp and mixed well. The mixture is retained for 16-24 hours at room temperature. The juice is then separated from the pulp by passing through cheese cloth in a basket press or by passing through a filter press. The juice thus obtained is then racked at 3-5°C for 2-3 days during this period, all the remaining suspended particles in the juice settle down. The clean supernatant is then filtered by using filter aids and stored after pasteurisation. In order to obtain clear juice from fruits like grapes, enzyme treatment is given to the must prior to juice extraction. When Bangalore Blue grape are treated with 0.23% (by wt.) of pectolytic enzyme, the juice yield increases by nearly 13%. The sedimentation in such case is over within 24 hours, and argols separate out within a week.

Some data obtained during preparation of liquid fruits from guava, banana and grape are as follows:

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Sl. No.	Particulars	Guava		Banana		Grape	
		Pulp	Juice	Pulp	Juice	Pulp	Juice
1.	Total soluble solids (^{o}Brix)	10.1	10.1	20.9	21.6	17.5	18.0
2.	Acidity %	0.42	0.49	0.53	0.53	1.12	1.21
3.	Total sugars %	5.94	6.78	13.30	15.05	14.05	11.80
4.	Starch %	2.62	Nil	4.41	Nil	-	-
5.	Ascorbic acid	155	185	-	4.0	-	-
6.	Yield (% on pulp basis)	-	80-85	-	75-82	-	56
7.	Enzyme dose (% by wt.)	0.4	-	0.3	-	0.25	-

Similar enzymatic treatment can be given to other fruits like mango, papaya, jackfruits, pears and apples The quantity of enzyme required will vary depending on the composition of fruits; however, it ranges generally from 0.3 to 0.5 per cent. Pectolytic enzymes can also be used for the preparation of lime juice cordial. When PEC is added to lime juice at one per cent level, the pectin content breaks down almost completely within 72 hours. The viscosity of the juice is thus reduced and consequently the suspended particles in the juice settle down. The juice is then filtered and a clear product is obtained. The whole process is completed within a week whereas the conventional process to prepare clear lime juice for making cordial takes a few months.

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The liquid fruits can be consumed as such or can be converted into carbonated beverages and used as ready-to-serve beverages. It can also be used as a base for producing fruit juice powders and preparation of ice-cream.

The release of technical 'know-how' to prepare pectolytic enzyme is covered under a technical fee of Rs.4,000/- on non-exclusive basis. The know-how to use pectolytic enzyme for preparation of liquid fruits is demonstrated against a fee of Rs.1,000/- only. For details, please contact the Director, Central Food Technological Research Institute, Mysore-570 013.

The following machineries and equipment are essential for setting up a unit for manufacture of liquid fruits:

1) Pulping machine
2) Steam-jacketed pan
3) Filter press
4) Bottle washing machine
5) Storage tanks
6) Boiler
7) Bottle filling machine

In addition to the above, a cool room having a temperature between 3 to 5°C will have to be set up to keep the pulp/juice for sedimentation.

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The capacity of the above mentioned machineries and equipment will depend on the out-put of the liquid fruits required for 8 hours working shift.

Preservation of Fruits & Vegetables:- Fruits and Vegetables are an important nutritional requirement for the people as they not only meet the quantitative needs to some extent but also supply vitamins and minerals which improve the quality of the diet. Most of the fruits and certain vegetables produced in the country are seasonal. A sizable portion of the seasonal surpluses goes to waste due to improper prepackaging, handling, distribution and marketing. Therefore, if these losses are to be prevented and seasonal surpluses made available for human consumption effort should be made to preserve atleast a part of these surpluses for consumption during the lean periods. If such efforts are successful, they would stimulate an increase in production, bring better returns to the agriculturists and improve the nutritional standards of the people at large.

Fruits and vegetables are considered as highly perishable commodities and the spoilages occur in a variety of ways. The spoilage can be prevented by adopting any one or a combination of the following methods.

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1. Preservatives:- Chemical preservatives like sodium benzoate and potassium metabisulphite help to prevent or retard spoilages in products such as squashes, syrups (fruit and synthetic), cordial, barley waters, crushes, juices and tomato ketchup.

2. Salt:- Pickling by salting has been practised since ages. Preservation by salting is affected because of its power to absorb water from the medium, to remove water from the microbial cells thereby making the medium inaccessible to microbial attack, and ionisation of salt into sodium and chloride which inhibits the microbial growth. Salt pickles are examples.

3. Sugar:- Sugar in concentrations above 68 per cent acts as a preservative by osmosis and not as a true poison for microorganisms. Examples are jams, jellies, marmalades, preserves, candies, etc.

4. Vinegar (Synthetic):- Vinegar is a dilute solution of acetic acid in water which contains not less than 3.75 per cent of acetic acid. Vinegar pickles are safe from any spoilage due to the high percentage of acid.

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5. Canning/Pasteurization:- Heat treatment of a food in hermetically sealed containers at a sufficiently high temperature for optimum period to destroy a majority, though not all, of the micro-organisms thereby prolonging the keeping quality of that food is known as canning. The heat treatment given cooks the food making it more nutritious and palatable, destroys or renders inactive all organisms and enzymes in contact with the food, and develops some degree of vacuum within the container making possible a reliable hermetic seal. Examples are canned fruits and vegetables, juices, pulp, etc.

6. Dehydration:- This is an age old method of preserving certain foods practised in all households. Dehydration means removal of moisture in food stuffs to such a level that the micro-organisms responsible for spoilage cannot grow. Examples are dehydrated green peas, potatoes, cabbage, cauliflower, green mango slices, etc. About 800 tonnes of dehydrated foods valued at Rs.10 millions were exported from India during 1976-77 indications are that the exports would touch 1,000 tonnes mark during current year. In addition about 200 tonnes dehydrated vegetable are supplied to the Defence and Civil markets by the eight licenced units. Utilization of capacity is less despite a huge demand potential estimated at over 10,000 tonnes in respect of dehydrated

onion only. Dehydrated potatoes, particularly granules and flakes also offer substantial scope.

Wax emulsion for coating of fruits & vegetable to extend their storage life:

More than 90% of the available cold storage capacity in the country is being used for storing potatoes. Refrigeration facilities for other perishable are naturally far short of needs. In the absence of adequate cold storage facilities, waxing of fruits and vegetables is an alternative means of extending their storage life and for reducing spoilage during storage, transportation and marketing.

Different compositions of wax emulsions have been formulated, and after trials, two of them, namely, Waxol-W-12 and Waxol-O-12, have been recommended for coating commercially important fruits. Wax emulsions can be applied just after harvest at orchards, warehouses, market centres or at home. The microbial damage to fruits is checked by incorporating certain fungicides in the emulsions, and their colour improved by growth regulating chemicals.

Vegetables like cauliflower, cabbage, french beans, beet-root, knol-kohl, spinach and radish are not amenable to wax treatment; microbial spoilage of these vegetables

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can be controlled by washing them with certain acceptable chemicals.

The Institute supplies wax emulsions and detailed information on its preparation and methods of treatment.

Potato Chips:- Potato chips constitute a high energy food. They are produced by rapid dehydration of potato slices by direct contact with hot fat. Mature tubers of high specific gravity (1.07 and above) and low sugar content (reducing sugars, 0.2% or less) are selected for processing. The tubers are peeled by abrasion, lye or steam, and trimmed by hand. They are then sliced into plain or regular discs (0.85-1.7 mm. thick) or they may be given a wavy or waffle cut. The slices are then washed to eliminate starch from the surface and all superficial water is removed before frying. For minimizing discolouration, the slices are dipped in hot (85-95°) dilute solution of sodium bisulphite, with or without phosphoric acid, sodium citrate or calcium chloride, for 1 min. or more. They are then fried in hydrogenated vegetable oil shortening, the temperature of frying varying from 175-90°C at the feed-end of the frying kettle to 160-75°C at the finishing-end. Only vegetable oil shortening or oils like cottonseed, corn or peanut oil is used by the chip industry. As the chips emerge from the fryer, excess

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oil is drained off and the chips salted; an antioxidant, e.g. butylated hydroxyanisole (BHA), is added to the oil or to the salt when non-hydrogenated oils are used as frying medium. The amount of salt applied varies from 1.5 kg to 2.0 kg per 100 kg of fried chips. Flavouring materials may be added by dusting or sprinkling on chips in a rotary drum drier; the addition of monsodium glutamate intensifies the flavour. Drying of chips to the desired 2 per cent moisture after frying is a critical operation.

Fried chips are packed in cans or in flexible packaging material, like waxed glassine, to prevent loss of crispness or development of rancidity.

6.5 SPICES:

Chillies:

(1) Improved method of Sun-drying:- India produced 4,88,000 M.T. of dry chillies in 1973-74. The chillies harvested during December - March have a peak marketing season from March - June. Traditionally fresh chillies are preserved by sun-drying, to facilitate their availability throughout the year for internal consumption as well as export.

In the traditional method fresh red chillies are dried in sun by spreading on the ground in single layer

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with frequent turning over and then stacked in heaps. Depending on the initial moisture content (usually 74%) the process take 15-21 days to dry the chillies to about 15-20% moisture content. This method is unhygienic, time consuming, and gives lower yield of dried product due to loss of seeds by breakages and causes fading of colour during storage, making the product unattractive. Also in this method the turnover of material and capital is slow.

CFTRI have developed an improved technology for sun-drying of chillies which have several advantages over the traditional method.

Advantages of improved technology:-

a) The rate of drying is faster, and hence the time taken for drying is only a week compared to 15-21 days in the traditional method.

b) Requires less space.

c) Better retention of colour and pungency.

d) Gives a hygienic and superior quality product.

e) Gives higher yield of finished product (2% more) due to minimum breakage and loss of seeds.

f) The improved method adds no extra cost to the finished product.

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Field demonstration using Bhivapur variety of chillies have shown that red chillies sun-dried by the improved method brings an additional economic benefit of Rs.50/- per quintal.

Improved Technology:-

a) Dipping fresh chillies in the emulsion (Dipsol) for 5 minutes.

b) Draining the excess emulsion.

c) Spread the material for drying on racks having multi-tier wire net trays - at the rate of 5-10 kg per sq.m. of tray area depending on ambient temperature.

The treated material dry to commercial level moisture content in about a week's time.

Preparation of Emulsion - 'DIPSOL':- 'Dipsol' is a water-based emulsion containing Potassium Carbonate, refined groundnut oil, gum acacia and Butylated hydroxy anizole (BHA).

100 kg of Dipsol contains:

Ingredient		Percent composition
Potassium Carbonate	-	2.5
Refined groundnut oil	-	1.0
Gum Acacia	-	0.1
B.H.A.	-	0.001

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Dissolve potassium carbonate and gum acacia in water separately. Similarly dissolve BHA in refined groundnut oil. Mix the water phase solutions and add BHA dissolved groundnut oil slowly while stirring. The mixture is passed through a homogeniser twice at 200 kg/sq.cm.

About 7.5 litres of the emulsion is required per 100 kg of fresh chillies and it will cost Rs.10.50.

(2) Compressed packing of dry red chillies:-

1. Some of the chilli exporters intend to export Indian dry chillies to Western Countries. For this the chilli packages should not only look eligent but also the chillies should retain freshness and red colour during transport and storage. The studies on compressed packages of dry chillies have revealed the above advantages, i.e.

a) The retention of freshness and red colour is very good

b) Considerable saving in space

c) Considerable saving in freight charges

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Summary of Research Work:

2. (a) Equilibrium moisture relationship studies indicated that chillies at 15% and above moisture level developed fungus growth during storage. Chillies packages to be exported to Western Countries need polyethylene lining to prevent the moisture ingress to avoid the fungus growth.

(b) Compressibility studies of Chillies:- Dry chillies at moisture level of 10.5% and above could be compressed to ¼ th to its original volume without any breakage.

(c) A suitable frame was desired to that the chillies could be compressed and the frame removed and the chillies under compressed condition either stitched or bailed before pressure is released and package taken out.

3. Equipments required:

a) Frames using M.S.Iron plate of thickness 1/8"

For 10 kg	-	20" x 15" x 20"
For 25 kg	-	30" x 20" x 25"
For 50 kg	-	30" x 20" x 50"

The plates could be jointed together using hinges and a locking arrangement to joining plates.

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b) Power or hydraulic press of capacity 10 to 25 tons.

Platform size 3 x 2 ft. having a frame for bailing.
Piston movement 4 ft.

Addresses of the firm who supplies the power or hydraulic presses:

i) M/s.K.G.Khosala & Co.Pvt.Ltd.,
Engineers & Agents, I Deshabandhu Gupta Road,
New Delhi - 1.

ii) M/s.Perfect Machine Tools Co.,
Bell Building, 1st Floor, Sir P.M.Road, Fort,
Bombay - 1.

(3) Mechanical drying of Chillies:

Red Chillies:- During the drying season of chillies it was observed that due to untimely rains and inclement weather conditions, wastage of chillies to the extent of 70 to 80% occured in some years.

Mechanical drying of chillies becomes essential in such years to avoid the large wastage. To meet the requirements of Nagpur Zilla Parishad for a suitable mechanical dryer for chillies, studies have been conducted at the Institute for fluidized Bed drying which is a latest technique of mechanical drying. From these studies it was observed that chillies (stem cut and pricked) took about 4 hours to dry from initial moisture content of 74-75 per cent to a final moisture content of about 8%; at 60°C. The retention of quality characteristics was

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found to be (1) Capsaicin (pungency) 95% and colour (Total colouring matter expressed as capsanthin) 92%. As design parameters like (1) Minimum fluidization velocity (2) drying characteristics (3) Heat and mass transfer coefficients are not available in the literature for Fluidized Bed Dryer of an irregularl, shaped material like chillies, these parameters have also been determined from these studies. To extend the working of the Fluidized Bed Dryer beyond the chilli season other food commodities like green chillies, ginger, garlic, green peas and orange peels, etc., have also been dried in it with encouraging results. The F.B.D. has the following advantages:

1. Plant is simple in design and operation.
2. Capital investment is comparatively less due to higher out-put.
3. Requires minimum drying time at low temperature like 60°C.
4. Quality retention is maximum.
5. Cost of drying is expected to be lower as compared to other commercial dryers.

Development Corporation of Vidarbha Ltd., may sponser the work pertaining to scaling up the dryer to 1 tonne per 8 hours shift capacity to establish its commercial feasibility for meeting the requirement of growers in the region.

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Drying of Ginger:

Ginger for preserving by syruping is grown commercially chiefly in China, Formosa and Hong Kong and more recently in Australia. On the other hand, dried ginger for essence (oil) extraction or grinding as a spice is produced mainly in Jamaica, Siera Leone, Nigeria and India.

Raw Material:- The time of harvest of ginger is very important not only from the point of view of yield to the grower but also from quality considerations as influenced by oil and fibre contents. Not only the rhizome weight but also the fibre and oil contents increase with maturity. If the ginger is meant for syruping, it should be harvested early to ensure a low-fibre content. In the case of dried ginger, the optimum maturity at harvest will be determined by the use for which it is meant - whether as a ground spice or for oil extraction. While in the latter case, high fibre content is not undesirable in view of the concomittantly high oil content in the former case, the fibre content should be only of a medium order. In fact, by using ginger harvested fairly early, one can get a product with sufficient ginger flavour but without too much heat. In view of its thinner skin, it will also possess a more attractive appearance.

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Another problem with regard to raw material is the problem of hard centres. As is the case with a number of other crops, where the ginger crop suffers from any severe setback such as drought, there is a tendency for the rhizome to develop a hard dry centre; this is later surrounded by normal quality young material when good growing conditions prevail. The best method to overcome this problem is by irrigating the crop.

Peeling:- Since the skin of the ginger is an almost impervious barrier to the transport of moisture from within, atleast partial peeling of the rhizomes is an indispensible prerequisite for satisfactory dehydration of ginger. In view of odd size and shape of the ginger rhizomes, complete peeling can be carried out only by hand peeling using knives and this is necessarily a laborious and time-consuming operation.

It has been reported in the literature that Jamaican ginger is usually peeled by immersion for one minute in boiling water when the skin comes off easily. Results of treatment of Indian varieties of ginger with boiling water were, however, negative in that, it was not possible to peel them merely by treatment with boiling water. Even lye peeling was not successful.

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Expreiments carried out at the Central Food Technological Research Institute, Mysore-13, has shown that partial mechanical peeling of ginger can be carried out using an abrasive peeler such as is used for the peeling of potatoes, beet-root, carrots, etc. In regard to both loss of volatile oil and time of drying, the fully hand-scraped ginger approximate closely the sample abrasive-peeled for 60 seconds correspondingly to a peeling loss of 10 - 12%.

Sun-Drying:- Since there is practically no difference in the appearance and quality of sun-dried or dehydrated ginger, dehydration needs to be resorted to only if there are adverse weather conditions at the time of harvest.

Under the most favourable conditions for Sun-drying in Mysore during March-April with an ambient temperature of 24-28^{o}C in the shade and a relative humidity of 20-30%, the time of drying for ginger abrasive peeled for 60 seconds was found to be 7 days.

Dehydration:- In countries like Australia, the rotary drier is the preferred type of dehydrator for ginger in view of the less labour involved; but in developing countries where labour is fairly cheap, the tray and tunnel drier should be satisfactory.

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The critical temperature of dehydration of ginger is 60°C. If the ginger is allowed to attain higher temperatures during dehydration, the colour is appreciably darker and may be unattractive for use as spice. However, since higher dry bulb temperatures upto 80°C has no adverse effect on the volatile oil content of the dried ginger, the higher temperatures can be used where the material is meant for extraction purposes only with correspondingly greater throughout. For extraction purposes, it is not necessary to peel the ginger; it can be more advantageously sliced.

The drying time of ginger (medium-size) abrasive peeled for 60 seconds at a tray load of 1.0 kg/sq.ft. and dry bulb temperature of 60°C is 24 hours in the cross-flow drier and 14 hours in the through-flow drier. The lower drying time in the through-flow drier is presumably due to more intimate contact of material and the drying air.

Packaging:- Packaging studies with sliced and ground-dried ginger in different types of multi-wall paper bags over a 5 month period have shown that there is a 50% loss in volatile oil in the case of ground ginger; whereas there is practically no change in the oleoresin content in the case of either the sliced or ground samples. It is, therefore, preferable to store the dried ginger in the form of slices rather than powder until use.

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Manufacture of Garlic Powder:

Garlic powder, which is mainly used as a condiment in food preparation, also serves as carminative and gastric stimulant in many medicinal preparations. As a condiment, it is used for flavouring mayonnaise and tomato ketchup or sauces, salad dressings, meat sausages, gravies, stews, spaghetti, chutnies, pickles, curried dishes, etc. It aids in digestation and absorption of food, possesses anithelmintic and antiseptic properties and because of these properties, it is used in a number of medicinal preparations.

Manufacture and marketing of garlic powder is a well established industry in the U.S.A. and Europe; its uses in these countries are well established. In India, though garlic is grown abundantly and consumed as such, no efforts have so far been made to produce dehydrated garlic or garlic powder with the result that nearly 20% of the crop is wasted due to respiration, transpiration and microbiological spoilage during ordinary storage of garlic bulbs.

The conventional technique of making garlic powder consists in removing by hand the outer papery skin of the garlic bulb, separation and peeling of cloves manually. Dehydrating and powdering them before packing. This technique is tedious, labour and time consuming and hence costly.

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This Institute has worked out an improved process for making garlic powder. The garlic bulbs are scrubbed under mild pressure by hand to remove the outer papery skin and the cloves separated. The cloves are then subjected to mechanical treatment in a twine or tripple roll mill and dehydrated by traying or columning. Dried and cleaned cloves are powdered to the desired mesh-size and packed in air-tight containers.

The garlic powder thus prepared can be used both as condiment and also in the manufacture of several pharmaceutical preparations.

The technique effects considerable saving in labour and reduces the dehydration time by 25-50% depending upon the method of dehydration employed. The product obtained possesses better colour, flavour, antibacterial activity and pharmaceutical value than that prepared by the conventional technique.

The development of garlic powder industry, apart from utilising undersized but healthy garlic bulbs, which otherwise, fetch low prices, will assist in keeping the market rates fairly uniform particularly during the glut seasons.

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Oleoresin from Spices (Chilli & Ginger):

The oleoresins or spice extractives are in great demand by the meat processing and canning industries in foreign countries. With the know-how and equipment designs developed by the Institute, high quality oleoresins are now being produced commercially from major spices, which constitute new foreign exchange earners for the country. The know-how has been sold so far to 13 firms.

Oleoresin from chillies consist of fixed oil, capsaicin, pigments, sugars and resins. The oleoresin yield from chillies varies from 8.7 to 16 per cent with 2 to 3.5 per cent capsacin and about 0.114 per cent colour as B-carotene. Ethylene di-chloride is a good solvant for oleoresin extraction. The oleoresin of ginger is extracted with solvent like acetone, alcohol, Ethylene de-chloride, Hexane or Ether, The oleoresin contains the pungent principle Zingerone (3.5 to 5 per cent), gingerone (25 per cent) and essential oil (26 per cent). Ethylene di-chloride extracted about 5.4 per cent oleoresin from ginger.

6.6 STARCH MANUFACTURE:

The economical sources of starch are mainly tubers like Tapioca (Manihot utilissima or Cassava) and potato. Others are Maize, Arrowroot, tamarind seeds, Sorghum, etc. The table 6-2 presently the starch content of these commodities:

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TABLE - 6-2

Starch content in economically utilizable commodities

Name of the commodity	Starch content % on dry basis	Ratio of amylose/ amylopectin
Tapioca	78 to 90	16 : 84
Potato	65 to 80	24 : 76
Maize	68 to 74	27 : 73
Arrowroot	55 to 70	20 : 80
Tamarind seed	60	
Sorghum	72 to 75	23-28 : 72-77

The installed capacity and production of starch in the country (1971) was 1,68,690 tonnes and 93,213 tonnes respectively. The import and export of starches were 11,930 kgs. valued at Rs.53,902 and 1,52,357 kgs valued at Rs.1,52,469 respectively. Maiz e, tapioca and tamarind can be procured for manufacture of starch in the region. Methods of starch preparation from these raw materials are available.

Since tapioca is the cheapest raw material with maximum starch content, a starch unit can be set up as and when tapioca production increases to a required level.

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Malt from Ragi or Jowar:- Good quality seed grains (with percentage of germination not less than 90%) should be taken for preparing malt. The process involves the following steps.

Cleaning and steeping of the grain:- The grain is first cleaned to remove mud, stones, etc., by winnowing and then washed well with water. It is then steeped in water in a tall vessel, so that the grain is not more than one third the hight of the vessel. Water is allowed to flow in by means of a rubber tube attached to a pipe and allowed to overflow over rim of the vessel.

Couching:- After the grain is steeped for 24 hours, it is taken out of the steeping vessel and spread on a clean gunny matting in a cool dark place. The depth of the grain should not be more than 2". A second wet gunny matting is used for covering the wet grain. At the end of every 24 hours, the cover is removed, the grain is piled up in the centre of the bottom gunny and sprinkled with a little water. The grain is well mixed and respread again as before. The couching period is usually 72 hours.

Drying:- At the end of 72 hours from the day of spreading on the gunny the grain is taken out and spread out either in trays or on a clean cement floor in the sun

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and allowed to dry, with occasional stirring. When the grain is completely dry it is placed on a dry gunny sack and gently rubbed to separate all the vegetative portion from the grain. The vegetative portion is removed from the grain by winnowing.

Roasting, Powdering & Sieving:- The grain is next roasted gently in an iron pan to develop the malt flavour; the pleasant aroma will give an indication of the degree of roasting to be done. Over roasting should be strictly avoided as this will affect adversely the malt flavour. The roasted grain is powdered to fine flour and passed through a 70-80 mesh sieve.

The malt flour thus obtained can be preserved in air-tight tins for a period of about one month.

Nutritive value:- During malting a part of the starch present in the grain is converted into dextrins and maltose. There is also a slight increase in the content of B-Vitamins. Malt is more readily digested by infants than cereal flours - there is practically no change in the content of proteins and minerals.

Low-fat Groundnut Flour:- The method adopted for the preparation of white groundnut cake flour is given below:

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Roasting and decuticling of groundnut kernels:- Groundnut kernels of good quality are cleaned to remove foreign matter like stone broken shells and damaged seeds. The cleaned kernels are then given a light roasting for about 10 minutes either in an open pan roaster or on electric roaster of the type of coffe roaster to facilitate the removal of the cuticle. The heated kernels are then cooled and the cuticle (testa) removed by rubbing the kernels and blowing off the detached cuticles in a current of air. Spoiled seeds present are removed by hand picking.

Preparation of groundnut cake:- The decuticled kernels are then crushed in an oil expeller. The resulting press cake has a light yellow brown colour.

Preparation of groundnut flour:- The cake is powdered in a disintegrator or flour mill. The resulting groundnut cake flour has an attractive light yellow colour and an acceptable taste and flavour. It contains about 6-10% of oil but keeps well in air-right containers for a period of 6 to 8 months without developing any off-flavour.

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Malt Food Ingredients:-

Jowar or Ragi Malt -

Low fat groundnut flour -

Puffed Bengalgram flour -

Skim milk powder -

Vanaspathi -

$Ca\ Co_3$ -

$Ca_3\ (Po_4)_2$ -

Fortification with Vitamins:- The malt food as obtained above is further fortified with vitamins. Addition of sugar, cocoa and flavours like vanilla will improve the taste of the product.

Packing:- The malt food is packed in 1 kg and ½ kg quantities in alkathene bags which are in turn packed in 28 lb. tins with lever lide and tagger tops.

Traditional Packages & Packaging materials:- Leaf cups of various sizes and shapes from Banana and Butea have been made. A simple machine is being developed to press and trim the leaves into cups. This machine has a capacity to produce 1000 cups per day. Cup making from Butea leaves can be adopted for the benefit of tribal people in the forest areas of Chandrapur, Yeotmal and Amraoti (Melghat area) districts.

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Confectionery:- Since two sugar factories have been set up in the region, one each at Dusarbid (Buldhana) and Pofali (Yeotmal), the setting up of a suitable confectionery unit one each at Khamgaon and Yeotmal can be considered. Details in these regards can be obtained from Indian Institute of Sugar Technology, Kanpur.

6.7 FISHERIES:

In land fisheries in Vidarbha is being developed by bringing seeds of Rhu, Katla and Mrugal from Calcutta. However there is no consistency in the production of fish. As the tanks are located in the interior, problems of transfer arise particularly in the rainy season. The baskets in which fish is carried needs improvement. In the interior places, it is difficult to get even ice for the preservation of fish. It is absolutely essential to make arrangements for providing adequate quantities of ice through the fisheries co-operatives for transport of fish.

The Institute has designed an insulated drip-proof bamboo container for transport of fish. The purpose of this improved fish container is to prevent loss of fish on account of it becoming unsaleable due to excessive melting of ice and subsequent spoilage in hot tropical climate. It is insulated with double layer of polythylene lined bitumen coated gunny. The insulated liner

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is padded with coir to 1" thickness and inserted between two different sized bamboo baskets; an inner smaller basket being fitted into an outer large sized basket. The inner basket is lined with perforated polyethylene. These containers can be of variable sizes. However, the one designed at the Institute has a capacity of 2-2.35 cu.ft. and holds between 25-35 kgs. of fish and weighs about 7 kgs. The container is returnable and designed to last 6 trips. The saw dust packed below the inner basket makes it drip-proof by absorbing drip water.

Fish should be cleaned in running water before packing. About equal quantity of ice should be used in packing of fish. The ice should not be distributed equally but about 1/3rd quantity should be spread at the bottom, 1/3 distributed in between the layers and the remaining 1/3 spread on the top. This helps in keeping temperature even throughout the container. If fish is to be transported over long distances involving longer time, the fish should be re-iced if the quantity of fish shrinks too much.

A polythylene sheet (with punched holes in the central region) is provided for packing and overwrapping the fish. This sheet should be spread inside the inner basket with holes lying on bottom. This will allow the

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drip water to drain down. The drip water will be absorbed by the saw dust filled below the inner basket. The fish should then be packed and after top icing, wrapped with projecting sides of polythene sheet. After packing the fish, the lid should be fastened to the basket securely and the basket kept ready for despatch.

If the place is provided with cold storage facilities, the container may be left in the cold store till the time of despatch. This will prevent excessive melting of ice in the interval.

While stacking the basket in the railway carriage, piling baskets too high should be avoided. In case, ice factory is far away from landing place, the container can be improvised as an ice box and used for carrying ice upto the point of landing.

When the fish is brought in the retail market, it can be kept in ice be kept in ice in the container till the time it is sold. This will keep the fish in very good condition and will fetch better price.

Empty baskets after removing the gunny pad should be cleaned under jet of water and left in sun for drying. If possible, they can be dipped in diulte solution of

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bleaching powder (1000 ppm free chlorine) and then dried. This will effectively reduce the bacterial load. Similarly, the poly-sheet should be washed before re-use.

If the insulating material (gunny pad) has gone wet, it should also be dried. A wet gunny pad will be poor insulator. While packing, fresh saw dust should be used.

While returning, the baskets can be packed one inside another in inverted manner with poly-sheet and gunny pad placed inside. The Railways send these containers back to consigner at concessional rates if sent with in a certain period.

For journeys lasting 24 hours, the ice required under prevailing summer temperature, would be about 3/4 of the quantity of fish. About 1 kg of ice should be packed for every one extra hour for journey lasting over 24 hours. This is only stated as a general rule. However, the quantity of ice to be used can be determined under the operating condition taking into consideration time required and surrounding temperature. A few field tests can give this indication.

The container has been field tested and has been found satisfactory for transporting fish from Mangalore

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to Bangalore which involves more than 42 hours for fish to reach the consumers. The new container offers many advantages over the conventional bamboo basket.

1. It is insulated for increasing longer storage period.
2. It is more sanitary as it is drip-proof.
3. It is durable and can be re-used 6 times.
4. With proper chilling and icing, you can pack more fish and save ice.
5. The insulation liner does not involve any change in size, shape or the carrying capacity of the basket in use.
6. It can be used for transporting ice to fish landing centre.
7. It is easy to make.
8. It is economic to transport fish in this container as it carries more fish over longer distances with increased keeping quality and is returnable.

Frog Legs:- It is understood that there is a substantial demand for frogs at Bombay where four or five modern frozen food factories manufacture frozen frog legs mainly for exports. These factories require a regular and assured supply of frogs for meeting their export requirements. Chandrapur and Bhandara districts

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of the region have a potential for developing froggeries. It is reported that a quick survey of these two districts in this regard was carried out by one of the factories at Bombay. Data and information regarding development of froggeries can be had from Dr.Mandal, Central Indian Fisheries Institute, Barakpur, Calcutta. It may, therefore, be of interest to Development Corporation of Vidarbha Ltd., to organise this activity after its careful consideration inview of an assured market at Bombay.

Silk Worm Pupae:- Recent investigations carried out at the Institute, has indicated that by suitable pretreatment of the outer coat the silkworm pupae could be economically exploited for preparation of silkworm pupae meal.

Raw Material:- In the manufacture of commercial raw silk, the silkworm cocoons are steamed to stifle (to kill) the pupae and are then sorted out for reeling operation (Preparation of silk strands). The silkworm pupae that are discarded after the reeling operation constitute a good source of animal protein for livestock and poultry feed. At this stage they are having a tough covering of a protein-ous material (chitin) which has to be removed before this could be utilized further.

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Method of Manufacture:- The discarded pupae are collected and transferred to a vessel where this mass is boiled in dilute solution of caustic soda for a period of 5-10 minutes. This softens the outer coating and helps its easy removal in subsequent operation. The material is now carried to a washing tank, where the outer coat is removed manually, and the excess of chemicals is removed by washing in running water. The residue is collected and pressed by means of a hand press (or by an electrically operated screw press) to remove water, and the pressed cake is dried in a through-flow or cabinet drier. The artificial drying is carried out in batch operation and takes about 4-6 hours per batch for drying. Under favourable climatic conditions sun-drying can also be resorted to, to make it more economic. The dried pupae are further milled for mixing in feed or could be packed in gunny bags for bulk storage. In this state, the dried pupae remain in good condition for 1-2 months. Starting with 6 tonnes of raw material one tonne of dried product is obtained in the above process. The dried silkworm pupae produced in the above manner contain about 25 per cent fat which is a good source of energy in feed mixture. If fat is further removed by solvent extraction, the resulting product will have a better storage characteristics.

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The outer coating recovered during washing operation constitutes an another valuable by-product of silk industry. On further drying, this is sold as waste silk.

Chemical composition of Silkworm Pupae Meal(Percent)

Moisture	- 10
Crude protein	- 55
Lipids	- 25-27
Ash	- 5
Crude fibre	- 3

Amino Acids	Percent of protein
Lysine	- 5.7
Leucine	- 2.0
Isoleucine	- 3.4
Methionine	- 4.4
Phenylalanine	- 2.7
Valine	- 3.8

When compared with casein, its relative nutritive value was found to be 134 per cent and its pepsin digestibility was 89.5%.

The data presented here show that silkworm pupae meal is an excellent source of animal protein and fat.

The equipment and machinery required for the process is very simple consisting of a boiling vessel (made of either galvanized iron or lacquered drum),

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hand press or motor driven screw press, a through-flow drier or a cabinet dryer. The total cost for machinery required for ½ tonne/day capacity plant will not exceed Rs.5,000/-.

The cost of production is calculated at Rs.400/- per tonne and compared with the present selling price of Rs.600/- to Rs.700/- per tonne; the proposition seems to be extremely profitable.

The process is successfully applied in Industry by few firms in Mysore State. In areas where raw material is available in sufficient quantities the process can be profitably exploited.

Utilization of Agro-Industrial Waste, preparation of hard boards and particle board:

The agro-industrial wastes are used as raw materials in the process. They are chipped, sieved and blended with a dehydrating agent. Then it is dried and then a mat is prepared on cauls, either plain or corrugated or tapered. The mat is hot pressed and the boards are removed, cooled and trimmed.

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Design Basis:

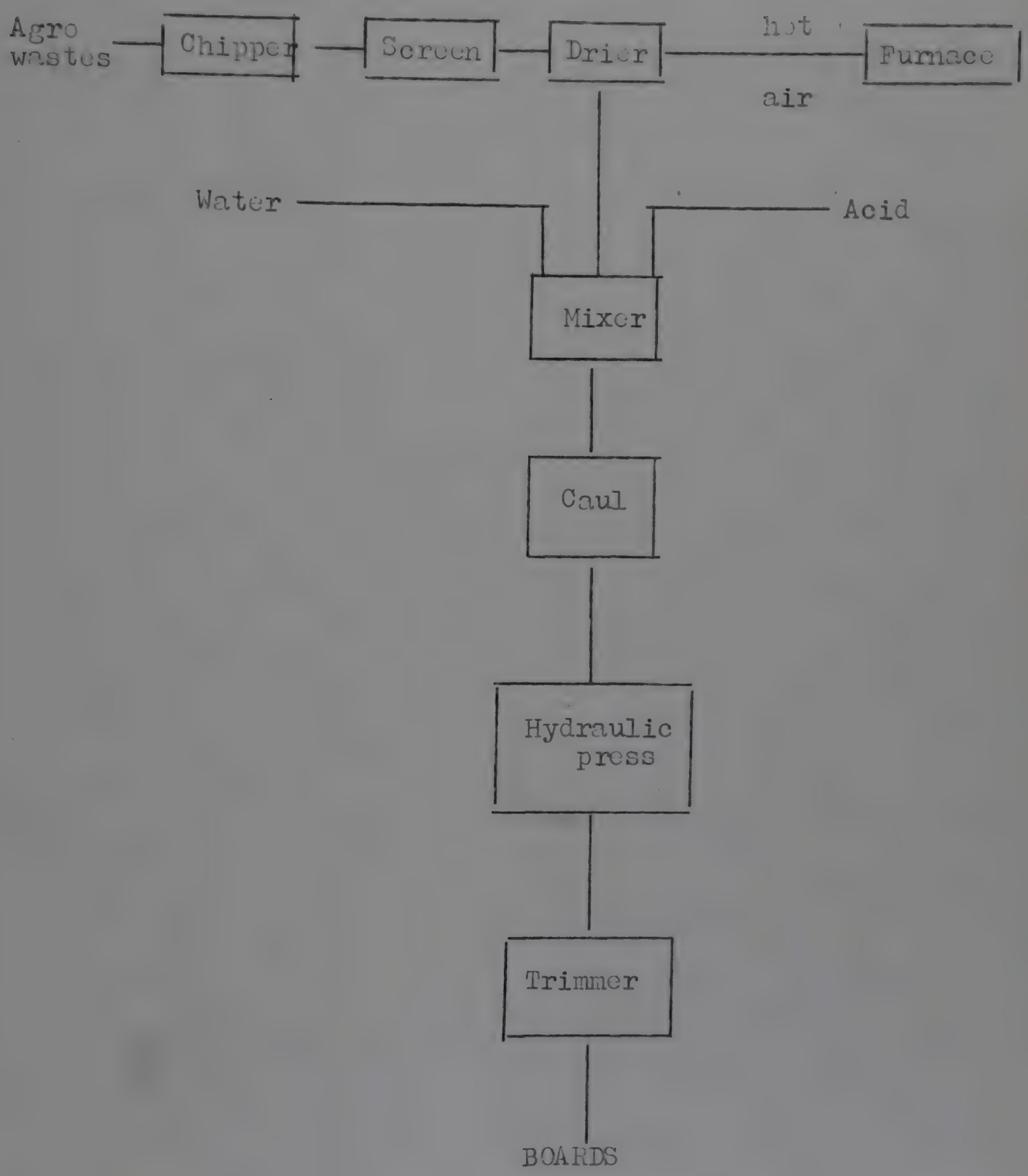
a) Product standard

	From wood wastes	From bag-asse	From ground-nut shell	From paddy husk	From coco-nut pith	From bamboo dust
Bending strength	210	180	170	160	88	225
Tensile strength kg/cm^2	90	80	75	73	38	98
Bulk density kg/m^3	1198	1160	1200	1280	950	1240
Water absorption % - 2 hrs immersion	3-5	6-9	6-10	5-13	12-58	6-10
-24 hrs immersion	5-10	14-18	10-13	6-23	38-68	10-15

b) Raw material standard

Agro-industrial wastes in particle sizes from 14-100 BS.

Block Diagram of the Process:



Manufacture of Corrugated Paper-Board:

1. Raw Materials:- Paddy straw, hessian (old gunny waste), grasses and other cellulosic wastes.

2. Product and Grades:- Liner paper and corrugated paper boards are manufactured in various grammages or grades depending on the end-use and capacity of machines.

3. Chief commercial use:- Products are mainly used for packaging.

4. Demand:- No figures are available. Several small units exist but these only convert separately purchased liner and corrugated papers to corrugated paper boards/ rolls.

5. Process suggested:- The scheme envisages an integrated project to manufacture liner paper, its corrugation and conversion to corrugated paper board/ roll. The process consists of alkali digestion of cellulose-based raw materials to yield pulp which is beaten in a suitable machinery. The beaten pulp is converted into liner paper/corrugated and the finally corrugated paper board/roll manufactured using starch as an adhesive.

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6. Technical Expertise:- The Regional Research Laboratory, Hyderabad can provide technical know-how and can also assist in the selection of equipment and other requirements.

7. Economic Unit:- A 25-tonnes per day unit is suggested.

The Capital investment, Plant capacity and Conversion cost, etc., for a number of product/processes are given in Table - 6-3.

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TABLE - 6-3

Capital Investment, Plant Capacity and Conversion Cost of Products/Processes

Sl. No.	Product	Capacity per day (8 hrs. shift)	Land & Building	Plant and Machinery	Working Capital	Total Investment	Conversion/ Production Cost (Rs./ tonne or kg)	Remarks
1	2	3	4	5	6	7	8	9
1.	Jowar Malt food	200 kg/day or 60 tons/ year	50000	44400	64032	158432	451	
2.	Rice Milling	2 ton/paddy per hr.for 20 hrs.a day	150000	150000	3000000	4050000	-	(Rs.8400000/annual turnover)
2A.	Rice bran stabilizer	3 tonnes	150000	including P&M	-	115000	55/tonne of stabilizer bran.	
3.	Improved disc sheller mill	0.8 tons paddy/hr. for 20 hrs a day.	-	40000	-	-	-	-
4.	Replacement of Huller mills by Mini-Mills	0.2 tons paddy/hr. for 20 hrs a day.		a)Centrifugal sheller 10000 b)Mixed emery rubber roller 15000	-	-	-	(80000 annual turn-over
4A.	Mini Rice Mill	500 kg/hr.	30000(cost of the unit)		-	-	35/tonne(processing cost of paddy)	

1	2	3	4	5	6	7	8	9
5.	Solvent Extraction of oil-cake and rice bran	60 tons/day oil cake.	600000	2400000	1000000	4000000	-	(105,00,000 annual turn-over
6.	Small Bakeries	250 loaves per day.	210000	280000	210000	700000	-	
7.	Dal Milling	8 tonnes	300000	(including P & M)	1800000	2100000 (for 3 months)	172.0	
8.	Gram frying units	60 bags	200000	300000	1000000	1500000	-	
9.	Active Carbon from rice husk	20 tons husk	180000	1465000	555000	2200000	2754	
10.	Ready Mix Flour	1 tonne	1250000	(including P & M)	400000	1650000 (for 90 days)	Rs.14/kg(for Sambar)	
11.	Infant Food	3 tonnes	320000	1000000	12499	1332499	4600	
12.	Protein Isolate from groundnut cake	5 tonnes	800000	(including P & M)	4500000	12500000 (for 3 months)	Rs.10/kg	
13.	Multi-purpose Food	5 tonnes	900000	(including P & M)	1200000	2100000	Rs.3.50/kg	
14.	Ediole groundnut flour	3 tonnes	700000	(including P & M)	1000000	1700000 (for 30 days)	Rs.2.40/kg	
15.	Miltone	5000 ltrs./day	100000	647140	162600	909740	32 N.P.per 200 ml bottle	

1	2	3	4	5	6	7	8	9
16.	Malted Beverage	300 kg/day	700000(including P & M)		250000 (for 3 months)	750000	Rs.15/kg	
17.	Vegetable Milk Curd	250 kg/day	7500	40000	12500	60000	Rs.440.00	
18.	Energy Food	3 tonnes	1290000(including P & M)		340000	1630000	Rs.3.60/kg	
19.	Weaning Food	3 tonnes	3200000(including P & M)		2000000 (for 3 months)	5200000	Rs.9.00/kg	
20.	Sesame dehulling and processing	5 tonnes	1900000(including P & M)		700000	2600000	Rs.6000.00	
21.	Fruit & Vegetable preservation unit	Small Scale 100 tons/ 200 days	260000(including P & M)		300000 (for 100 days)	560000	Rs.4000 to Rs.6000/tonne	
22.	Pectin from Citrus waste	45 kg/day	139000	921250	167000	1227250	Rs.51340	
23.	Oleoresin from spices	1 ton raw material	-	690000	750000 (for 2 months)	1440000	Rs.100/kg for Pepper	
24.	Improved method of sun-drying of red chillies	10 M.T. per week	5000	40000	17000	62000	Rs.6440	
25.	Corn flakes	1 tonne	200000	900000	300000	1400000	- (2500000 annual turn-over	

1	2	3	4	5	6	7	8	9
26.	Hard Board and particle board	3000 tons/ year	1850000(including P & M)		15000)	2000000	33 paise per sq.ft. of 8 mm thick	
27.	Corrugated paper sheet	25 tonnes	1800000	7000000	150000)	10300000	-	
28.	Lindane	25 kgs	194000(including P & M)		15800) (for 3 months)	352000	Rs.79.16/kg	
29.	Maize Mill	400 kg/hr	125000	-do-			Rs.68.00/tonne	

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CHAPTER - 7

Guidelines for setting up of industries based on available resources, infrastructure & technology

The guidelines for setting up of food processing industries in the region are divided into two categories; viz. (A) Developmental activities and (B) Others.

Food processing units to be set up along with tentative locations are indicated below:

Developmental Activities:

Food processing industry is an Agro-based industry which is given priority in our planned economy. Areas listed below should be taken up by the developmental agencies for establishing a nucleus for the rapid growth of this industry, and these may therefore be suitably phased. The demonstration-cum-training activities in this list will give a fillup for modernising the existing industry and setting up of new units in the region.

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Demonstration-cum-Training Activities:

Sl. No.	Food Processing Unit	Tentative Location	No.of Units	Reference Page No.	Reference S.No.of table 6-3 at pages
1	2	3	4		5
1.	Rice Milling:				
	a) Mini Rice Mills	Tumsar or Gondia, Talodi, Nagpur.	Three(Demonstration Units)	166	4A (273)
	b) Bran Stabilizer	Tumsar or Gondia, Talodi.	Two(Demonstration Units)	167-170	2A (273)
	c) Parboilng Unit	Tumsar or Gondia, Talodi.	-do-	170	--
	d) Modernization of Rice Mills(Financial provision in a phased manner)	Bhandara, Chandrapur, and Nagpur District.	Existing Units needing modernization.		4 (273)
2.	Modernization of Dal Mills (Financial provision in a phased manner).	Nagpur, Akola, Amraoti, Yeotmal & Bhandara.	-do-	194	--
3.	Infestation and Rodent Control	Nagpur, Akola, Amraoti.	Three(Demonstration-cum-Field Service Centres)	185 to 193	
4	Edible grade Groundnut cake, and MPF ½ tonne per 8 hours.	Wardha, Amraoti.	Two (Demonstration Units)	197-100	13 & 14 (274)

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1	2	3	4	5	
5.	Energy Food (3 tonnes per 8 hr.shift)	Chandrapur, Amraoti.	Two	217	18
6.	Orange processing unit juice, orange oil, RTS & carbonated beverages.	Nagpur, Amraoti, Katol and Wardha.	Four	221	21-22
7.	Wax-coating unit for Nagpur Santra.	Nagpur, Amraoti, Katol.	Three	239	-
8.	To propogate seeds of varieties suitable for canning, processing and dehydration of the following commodities:				
	a) Tomatoes	Nagpur, Yeotmal and Amraoti districts.	-	106	-
	b) Green peas	-do-	-	"	-
	c) Papaya	-do-	-	"	-
	d) Onion (white)	-do-	-	"	-
	e) Mango	Yeotmal district	-	"	-
	f) Ginger	Amraoti district	-	109	-
9.	Improved method of sun-drying of chillies	Umrer or Bhiwapur, Paratwada, Hinganghat, Malkapur.	Four (Demonstration Unit)	241	24
10.	Pearling of Jowar	Nagpur	One (Demonstration Unit)	159	-

1	2	3	4	5	
11.	Cups from Banana and Butea leaves	Malkapur, Selu, Tribal area in Chandrapur, Yeotmal and Amraoti (Melghat area)	Two / Three (Demonstration Units)	259	-
12.	Organisation of Froggeries	Bhandara and Chandrapur districts	-	264	-

Research Projects to be sponsored:

1.	Mechanical dryer (Fluidized Bed Dryer) for chillies; Project for scaling upto One tonne/8 hours.	C.F.T.R.I., Mysore.	One	246	-
2.	Improvement in the digestability of Jowar Kadba and Wheat straw; for feed purposes.	C.F.T.R.I., Mysore.	-	26	-

1	2	3	4	5
B) Others:				
1.	Modernization of Rice Mills	Chandrapur, Bhandara and Nagpur Districts	Depending on the existing machinery.	170	4
2.	Mini Rice Mills	At suitable places in Bhandara & Chandrapur, Nagpur & Melghat in Amraoti districts.	For replacement of huller type mills.	166	3.4
3.	Modernisation of Dal Mills	Nagpur, Akola, Amraoti, Yeotmal, Buldhana Dist.	Existing dal mills.	194	-
4.	Setting up of Modern Dal Mills 8 tonnes/day.	Pandharkawda, Pusad, Digras, Wani, Chandur, Achalpur, Warud, Washim, Mangrulpir, Hinganghat, Chikli, Mehkar, Shegaon, Sakoli.	14	-	7
5.	Composite programme for infestation and rodent control.	One each in every Panchayat Samiti.	-	185-193	-
6.	Instant Mixes for idli and dosa.	Nagpur, Amraoti & Akola	3	180	10
7.	Active Carbon from rice husk.	Bhandara and Chandrapur	2	182	9
8.	Solvent extraction plant (Cap.5 tons of bran/day)	Chandrapur	1	-	5

1	2	3	4	5
9.	Curing of new rice	Gondia, Talodi.	2	163 -
10.	Lindane manufacture	Nagpur.	1	190 28
11.	Papad making	All district places	8	195 -
12.	M.P.F.	Chandrapur, Amraoti, Yeotmal, Akola, Khamgaon and Nagpur.	6	200 13
13.	Weaning Food	Wardha	1	202 19
14.	Edible grade groundnut flour, protein isolate and infant food, coffee and tea whitner.	Amraoti	1	204 14
15.	Miltone	Nagpur	1	206 15
16.	Vegetable curd	All district places	8	210 17
17.	Protein Beverages	Amraoti	1	208 -
18	High Protein Biscuits and Chewy Candy.	Nagpur, Akola, Amraoti.	3	209 -
19.	Edible grade seasame flour.	Nagpur, Chandrapur.	2	220 20
20.	RTS & Carbonated Orange drink based on concentrated orange juice.	All district places.	8	222 -

1	2	3	4	5
21.	Orange oil	Warud, Nagpur, Katol, Amraoti.	4	222	-
22.	Antifungal paste for Banana	Wardha or Selu, Malkapur, Morshi or Warud.	1	223	-
23.	Papain from Papaya and Papaya candy.	Selu, Malkapur, Yeotmal and Nagpur.	4	224	-
24.	Liquid fruits	Wardha, Amraoti.	2	231	-
25.	Fruit Bars	Amraoti, Wardha, Nagpur.	3	229	-
26.	Potato chips	Nagpur, Akola & Amraoti.	3	210	-
27.	Improved method of sun-drying	Chilli growing centres in the region.	-	241	24
28.	Mechanical dryer for chillies	Umrer or Bhiwapur	1	246	-
29.	Oleoresin Plant for chillies	Nagpur.	1	254	23
30.	Mechanical dryer for ginger	Amraoti	1	250	-
31.	Corn Flakes	Chandrapur, Khamgaon	2	193-194	25
32.	Bengal-gram parching (Dalya) units	Akola, Gondia, Amraoti	4	196	-

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1	2	3	4	5
33.	Bakery & Biscuits	Akola, Amraoti, Khamgaon Yeotmal & Chandrapur.	5	197 -
34.	Insulated fish baskets	Bhandara and Chandrapur districts.	-	260 -
35.	Silk worm pupae meal	-do-	2	265 -
36.	Peanut butter	Amraoti, Akola.	2	216 -
37.	Sesame dehulling and processing	Chandrapur district	1	220 20
38.	Hard board & Particle board	Nagpur	1	- 26
39.	Manufacture of corrugated paper board.	Chandrapur or Gondia.	1	- 27
40.	Manufacture of roasted, deep fat fried, salted groundnut.	Akola	1	200 -
41.	Manufacture of malt food from Jowar.	Nagpur	1	256 1
42.	Manufacture of "77" Cola type carbonated drink.	Nagpur, Amraoti & Akola.	3	222 -

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Name of the districts - Food Processing Units to be set up:

1. Nagpur District:- (a) Mini rice mill, (b) Modernization of dal mill, (c) Demonstration-cum-field service centre and compsoite programme for infestation and rodent control, (d) RTS and carbonated orange drink based on concentrated orange juice, (e) Wax coating unit for Nagpur Santra, (f) Modernization of Rice Mills, (g) Propogate seeds of suitable varieties of tomato and green peas for canning, processing and dehydration, (h) Unit for pearling of Jowar, (i) Instant mixes for Idli, dosa and gulab jamun, (j) Manufacture of Lindane, (k) Papad making unit, (l)MPF Plant, (m) Miltone, (n) Vegetable curd, (o) Protein beverages, (p) High protein biscuits and chew candy (q) Edible grade sesame flour, (r) Papain from papaya and papaya candy, (s) Fruit bars, (t) Potato chips, (u) Oleoresin plant for chillies, (v) Improved method of sun-drying (w) Mechanical (Fluidized Bed Dryer) dryer for chillies, (x) B.Gram parching unit, (y) Hard board and particle board from Agri.waste, (z) Malted food from jowar.

2. Bhandara District:- (a) Modernization of rice mills, (b) Mini rice mills, (c) Modern dal mill (8 tonnes/day), (d) Composite programme for infestation and rodent control, (e) Active carbon from rice husk, (f) Curing of new rice, (g) Papad making unit, (h) Vegetable curd unit, (i) Protein beverages, (j) RTS and carbonated drink, (k) Manufacture of sodium silicate and silicagel from rice husk, (l) Bran stabilizers, (m) Rice bran oil (edible), (n) Leaf cups from Butea in Tribal area, (o) B.Gram parching unit, (p) Insulated fish basket, (q) Corrugated paper board.

3. Akola District:- (a) Modern dal mill, (b) Modernization of existing dal mills, (c) Composite programme for infestation and rodent control, (d) Instant mixes for idli dosa, etc., (e) Papad making unit, (f) M.P.P. Unit,

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(g) Vegetable curd, (h) Protein beverages, (i) High protein biscuit and chew candy, (j) RTS and carbonated orange drink based on orange juice concentrate, (k) Potato chips, (l) B.Gram parching unit, (m) Biscuits & Bakery, (n) Peanut butter, (o) Roasted, deep fat fried, salted groundnut.

4. Amraoti District:- (a) Mini rice mill, (b) Modernization of dal mill, (c) Modern dal mill (8 tonnes/day), (d) Composite programme, (e) Instant mixes for idli, dosa, etc., (f) Papad making unit, (g) MPF Unit, (h) Protein isolate, Infant food, coffee and tea whitner, (i) Vegetable curd, (j) Protein beverages, (k) High protein biscuits and chew candy, (l) RTS and carbonate orange drink from concentrated orange juice, (m) Orange oil, (n) Liquid fruits, (o) Fruit bars, (p) Potato chips (q) Improved method of sun-drying of chillies, (r) Mechanical dryer for ginger, (s) Leaf cups from Butea (Melghat), (t) B.Gram parching unit, (u) Biscuits and bakery, and (v) Peanut butter.

5. Yeotmal District:- (a) Modernization of existing dal mills, (b) Setting up of modern dal mills, (c) Composite programme for infestation and rodent control (d) Papad making unit, (e) MPF, (f) Vegetable curd, (g) Protein beverages, (h) RTS & carbonated drink based on orange concentrate, (i) Papaya candy, (j) Papain from papaya, (k) Pearling of jowar, (l) Oil mill for mahua seed oil, (m) Leaf cups from Butea (tribal area, (n) Biscuits and bakery.

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6. Chandrapur District:- (a) Mini rice mills, (b) Modernization of existing rice mill, (c) Composite programme for infestation and rodent control, (d) Active carbon from rice husk, (e) Solvent extraction plant, (f) Curing of new rice, (g) Papad making unit, (h) MPF, (i) Energy food, (j) Vegetable curd, (k) Protein beverage, (l) Edible grade seasame flour, (m) RTS and carbonated orange drink from concentrated orange juice, (n) Leaf cups from Butea, (o) Corn flakes, (p) Biscuits and bakery, (q) Insulated fish baskets, (r) Sesame dehulling and processing, and (s) Corrugated paper board.

7. Wardha District:- (a) Modern dal mill (8 tonnes/day), (b) Composite programme for infestation and rodent control, (c) Papad making unit, (d) Weaning food, (e) Vegetable curd, (f) Protein beverage, (g) RTS and carbonated drink from orange juice concentrate, (h) Antifungal paste for Banana, (i) Papain from papaya and papaya candy, (j) Liquid fruits, (k) Improved method of sun-drying, and (l) Leaf cups from Banana and Butea.

8. Buldhana District:- (a) Modernization of existing dal mill, (b) Modern dal mill, (c) Composite programme for infestation and rodent control, (d) Papad making units, (e) MPF, (f) RTS and carbonated orange drink from orange juice concentrate, (g) Papain from papaya, (h) Improved method of sun-drying of chillies, (i) Antifungal paste for Banana, (j) Leaf cups from Banana and Butea, (k) Corn flakes, and (l) Biscuits and bakery.

A map of Vidarbha showing number of food processing units proposed in each district is given on Page _____.

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LIST OF OFFICIALS CONTACTED

(1) Regional Directors of the following agencies:

i) Maharashtra State Finance Corporation
ii) Maharashtra Agro-Industries Development Corporation
iii) Maharashtra Industries Development Corporation
iv) Small Industries Service Institute

(2) District level officials (8 districts of Vidarbha)

i) Collector
ii) Resident Deputy Collector
iii) Deputy Collector (Planning)
iv) Chief Executive Officer (Zilla Parishad)
v) Industries Officer
vi) Social Welfare Officer (Zilla Parishad)
vii) Deputy Registrar of Cooperatives
viii) Chief Supply Officer (Zilla Parishad)
ix) Conservator of Forest/Forest Officer
x) Agricultural Officer
xi) Fisheries Officer
xii) Horticulture Development Officer
xiii) Block Development Officer
xiv) President, Panchayat Samiti

List of places visited

1) Akola District: Akola, Karanja, Washim

2) Amraoti District: Amraoti, Achalpur, Morshi, Daryapur, Melghat, Anjangaon, Warud, Dharni.

3) Bhandara District: Bhandara, Tumsar, Condia

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4) Buldhana District: Buldhana, Khamgaon, Nandura, Malkapur

5) Chandrapur District: Chandrapur, Warora

6) Nagpur District: Nagpur, Katol, Umrer, Bhiwapur, Kalmeswar

7) Wardha District: Wardha, Selu, Samudrapur, Waigaon

8) Yeotmal District: Yeotmal, Pusad, Wani

Members of the Survey Team

1) Dr. M.S.Laul, Project Coordinator, CFTRI Experiment Station Nagpur

2) Dr. S.L. Bhalerao, Scientist -do-

3) Shri G.V. Mulmuley, SLA & -do-

4) Shri V.B.Dalal, Scientist, CFTRI, Mysore.

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